OCTOBER

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

Oral Sepsis in Childhood—*Brennemann*
Fusospirochetosis—*Dean & Dean*
Restoration of Facial Dimensions—*Brown*
Biologic Problems in Orthodontia—*Orban*
Periodontoclasia—*Canby*
Amalgam Restorations—*Bull*
Local Anesthetics—*Miller & Stuart*
Pulp-Involved Teeth—*Jasper*
Condensites and Vulcanites—*Kimball*
Glass as Denture Base—*Lott*
Record Keeping—*Brandhorst*
Biologic Factors in Dental Disorders—*Rabkin*
Neonatal Line—*Schour*
Fusiform Bacilli and Spirilla—*Tunnicliff et al.*
EDITORIAL
Ninth International Dental Congress
COUNCIL ON DENTAL THERAPEUTICS
Accepted Dental Remedies
BUREAU OF PUBLIC RELATIONS
Dental Health of School Child—*Wisan*
DENTAL ECONOMICS
State Education and
State Medicine

CONTENTS

Raoul H. Blanquie, D.D.S. ..... Frontispiece

ORIGINAL COMMUNICATIONS

Oral Sepsis in Childhood.
By Joseph Brennemann, M.D. 1817
Cultural Studies of Oral Fusospirochetosis Correlated with the Gingival Exudate and Clinical Manifestations.
By Richard D. Dean, B.S., D.D.S., M.D., and Marguerite T. Dean, B.S., M.D. 1829
Restoration of Lost Facial Dimensions and Contour for the Edentulous Patient.
By H. O. Brown, D.D.S. 1845
Biologic Problems in Orthodontia.
By Balint Orban, M.D. 1849
Incidence of Pulpal Infection in Periodontoclasia.
By Clarence P. Canby, D.D.S. 1871
A Simple Method of Improving Amalgam Restorations.
By Francis A. Bull, D.D.S. 1880
Comparative Merits of Vasoconstrictors in Local Anesthetic Solutions: Their Practical Application.
By Howard C. Miller, D.D.S., F.A.C.D., and Carroll W. Stuart, D.D.S., M.D., F.A.C.D. 1883
Conservation of Pulp-Involved Teeth.
By E. A. Jasper, D.D.S. 1895
Further Determinations on the Strength of Denture Materials: Condensites and Vulcanites: A Progress Report.
By Horton D. Kimball, D.D.Sc. 1904
Bilateral Sinusitis: Report of Case.
By Edmund Branower, D.D.S. 1913
Advantages and Disadvantages of the Use of Glass as a Denture Base.
By Frank Lott, D.D.S., M.Sc. (Dent.) 1915
Record Keeping as an Asset to Practice.
By O. W. Brandhorst, D.D.S. 1919
Biologic Factors in Dental Disorders.
By Samuel Rabkin, D.D.S. 1932
The Neonatal Line in the Enamel and Dentin of the Human Deciduous Teeth and First Permanent Molar.
By Isaac Schour, D.D.S., Ph.D. 1946
Oral Surgical Procedures (Notes on a Natural Color Motion Picture).
By Harry J. Field and Alfred A. Ackerman, D.D.S. 1956
Significance of Fusiform Bacilli and Spirilla in Gingival Tissue.
By Ruth Tunnicliff, A.B., M.D.; E. B. Fink, Ph.D., M.D., and Carolyn Hammond, M.A. 1959

EDITORIAL DEPARTMENT

The Ninth International Dental Congress.—We Need Both. 1967-1972

Practice in Paragraphs 1972

COUNCIL ON DENTAL THERAPEUTICS

Accepted Dental Remedies 1974
Taxi—Not Admissible to A.D.R. 1975
Wetherill Prophylaxis Stain Remover—Inadmissible to A.D.R. 1977

BUREAU OF PUBLIC RELATIONS

Education of the School Child for Dental Health.
By J. M. Wisan, D.D.S. 1978
Tooth Customs of the Australian Aborigines 1990
The Prayer to the Rain God 1992
The Summer Round-Up of the Children: 1935 Annual Report 1996

DENTAL ECONOMICS

State Education and State Medicine 1998
Division of Oral Hygiene of the North Carolina State Board of Health 1999
The McDowell County Dental Clinic (Maintained by Levy), Welch, W. Va. 2001
The Public School Health Service of a Kansas Town.
By Thomas A. Mayhew, D.D.S. 2003
Maternal and Child Health Dental Program of the State of Indiana 2004
Palama Settlement's Dental Clinic for School Children, Honolulu, Hawaiian Islands 2005

MISCELLANY

Book Reviews 2010
Deaths 2010

CURRENT LITERATURE

Abstracts 2011

Announcements 2016

ADVERTISEMENTS

Index to Advertisements A-51
Classified Section A-40

The Journal of the American Dental Association. Vol. XXIII, No. 10. Published by the American Dental Association, 212 East Superior Street, Chicago, Ill. Yearly subscription $5.00. Entered as second-class matter, May 1, 1928, at the postoffice at Chicago, Ill., under the act of Aug. 24, 1912. Published monthly.

Copyright, 1936, by the American Dental Association.

UNIVERSITY OF TORONTO LIBRARY

RAOUL H. BLANQUIE, D.D.S., San Francisco, Calif.
Vice President of the American Dental Association

THE JOURNAL
of the AMERICAN DENTAL ASSOCIATION

Vol. 23 OCTOBER, 1936 No. 10

Original Communications

ORAL SEPSIS IN CHILDHOOD*

By JOSEPH BRENNEMANN, M.D., Chicago, Ill.

MY chief qualification for discussing oral sepsis in childhood before a society of dentists lies, perhaps, in the fact that I know relatively little about the subject, or, possibly more conservatively stated, that I feel that I know relatively little about it. There is also some confusion in my mind as to the significance and limitations of the term "sepsis" in this connection, a term not of my own choosing. In spite of these seeming handicaps, I must confess that I readily yielded to the importunity, even welcomed the opportunity, to present, not so much the pediatric viewpoint, which I would not assume to express, as my own individual ideas, which are the result of about thirty years of interest in the subject. There may seem to be a further handicap in that most of what I have to say is based on impression, clinical impression, except in one instance in which a considerable amount of laboratory and clinical investigation was done on my initiative. In spite of this apparent limitation, which, in some scientific circles, would make any possible contribution of little or no acceptable value, I am inclined to believe, as I look back through the vista of years, that, in certain subjects, impressional evidence gained from extensive and intensive clinical observation is at least as dependable as is laboratory, or assumedly more strictly scientific, evidence that is not adequately checked by clinical experience.

As I have said, I welcomed the opportunity to express both my impressions and my ignorance before a dental group because I believe that dentistry is as much a part of medicine in general as are otolaryngology, ophthalmology and all the other recognized medical specialties, and that there is greater need for mutually sympathetic cooperation here than there has been in the past. Dentistry does not consist merely in the extraction, filling and straightening of teeth, and in the

*Read before the Section on Medical Relations at the Seventy-Second Annual Midwinter Clinic of the Chicago Dental Society, Feb. 20, 1936.

treatment of apical abscesses and their complications and sequelae, as was long accepted by the laity and by physicians, and I feel that it is no insult to my hosts when I add, accepted and practiced by too many dentists. The keyword today is prophylaxis. John Dewey used to tell us that "the purpose of an institution is to do away with itself." In that sense, in the combined onslaught on etiology and prevention especially, the dentist and the physician must work hand in hand, each contributing what he alone can contribute from his own field that is necessary to the full functioning of the other. In this spirit of cooperation, I shall frankly express what I have to say.

I shall accept as my interpretation of the subject under discussion the local manifestations of infection in the mouth and adjacent structures exclusive of those of otolaryngologic interest, as well as their remote systemic effects. Some of these I shall pass over lightly as too obvious to require extensive consideration. Others will be discussed in greater detail, with due attention to what may seem an appropriate proportional allotment for the present purpose. It is impossible to keep apart the purely local and the systemic aspects, since the latter are a complex with often an undeterminable line of cleavage of systemic bacterial invasion, of toxemias, of congenital or acquired substandard bodily structure and function and of nutritional inferiority due to purely mechanical conditions that prevent the adequate intake, mastication and assimilation of essential foods.

One of the most difficult things to decide, often too glibly decided, in a given case is whether the mouth condition is the cause or the effect of a systemic condition, or whether both are the result of some other deeper underlying condition that has to do with diet and hygiene or some bodily peculiarity.

G. V. Black pointed out years ago the effect of acute infections on the structure of teeth in childhood. We are familiar with the local conditions that are produced by such chronic diseases as rickets, scurvy and syphilis and by the administration of such drugs as mercury, lead and bismuth. We also know that purely local conditions in the mouth may produce serious systemic disease; not so often, I am inclined to believe, as is assumed by certain dentists and physicians and so regularly by our medical columnists and lay writers. I believe that there is more often than is generally accepted a basic condition, congenital or acquired, dietetic or hygienic, that is responsible for both local and systemic invasion and that makes it impossible to demonstrate a cause and effect relationship between the two. The dentist is naturally in a better position to evaluate the effect of a systemic on a local condition than is the physician. It must be granted, on the other hand, that the latter is in a more strategic position to evaluate the effect of a local on a systemic condition, or of a condition that antedates both of them, because of his deeper and broader knowledge of the general etiology and nature of such systemic invasions, and also because of his all too frequent observation that, only too often, local therapy does not bring about the hoped-for systemic relief. Focal infection, which, as so regularly happens in medicine, reached a staggering height of interest a decade or so ago, is gradually finding its proper level as an etiologic factor in systemic disease as a result of the mollifying effect of mass experience. And, in this instance, both dentists and physicians lived in glass houses. I shall say more about this later.

Dental caries, the most serious local problem as the pediatrician sees it, may seem outside the present discussion. And

yet it involves the action of bacteria and seems inseparable from bacterial invasion of the gums, dental apices, alveolar walls and adjacent bone, and corresponding lymphatic structures. It is rather amazing with what complacency we have accepted so abnormal a condition in the past, content with repair of what seemed unavoidable, and with the toothbrush and dental floss as our sole means of prevention. The "clean tooth that does not decay" has not solved the problem of dental caries and its associated phenomena and never will. One has only to be reminded of the findings in certain aborigines who had no toothbrushes or dental floss, in wild animals similarly unequipped, and even more in those Eskimos that Thomas found in Greenland. You will perhaps recall that in one tribe which had never come in contact with white men and the dietetic customs of civilization, so-called, there was practically complete absence of dental caries and of scurvy; while, in another tribe contaminated by such contact, both were present in a high degree.

There is to me, too, something intriguing about the hours that our dog spends in exercising his dental apparatus by chewing on a bone or a rubber imitation or a chance book or slipper, while we grumble over a tough steak. The toothbrush does not merely clean and remove: it rubs and massages the gums into a better state of health and function. Back of it all, as it seems to me, lies the important fact that man is onmivorous and caters more to his appetite than to the mere satisfaction of his hunger or his nutritional needs. His higher intelligence, so often misdirected, has elaborated a culinary system that makes for foods that are not only agreeable to his palate but also require a minimum effort at mastication; with little thought, until recent time, as to the relative nutritional values of the innumerable articles that enter into his dietary equipment.

Dental caries and its accompaniment are today largely a class phenomenon, based partly on poverty and dietetic opportunism represented by the bakery and the delicatessen, but far more on ignorance in any stratum of society. Very early in my practice, I spent two nights waiting for the arrival of a baby in a humble cottage on the near west side. For supper, we had coffee and sweet bakery rolls; for breakfast, sweet bakery rolls and coffee. In the older children, the large square heads were suggestive of a former rachitic condition; in the younger ones, of an active rickets. All of the children were pale, sickly, hothouse products, and all had carious and infected teeth as a part of the general evidence of malnourishment and a poor hygienic condition. One can no more build sound teeth and bones without an adequate supply of calcium and phosphorus and vitamin D to aid in their utilization than one can, without good bricks and mortar and a good mason to put them in place to advantage, build a sound brick house that will weather the storms.

As a pediatrician and a member of the Food Committee of the American Medical Association, I am keenly aware both of the importance of vitamins and of our still abysmal ignorance concerning their optimal representation in our diet. We are quite familiar with the results of an inadequate intake of nearly all that have so far been discovered. The upper limit of safe tolerance, ultimate as well as immediate, remains to be determined. That tolerance for vitamins in natural foods cannot be overstepped, or is at least not likely to be, may be accepted. One cannot feel so sure, even in the present absence of evidence to the contrary, that synthetic and pure extract concentrates have not potentialities for harm.

It is well established that one cannot reason in full measure from one animal to another, from a laboratory animal to a child. Vitamin A apparently protects a rat on an unnatural synthetic diet against infections; a lack of vitamin B will rob him of his appetite on an analogous diet. Clinical evidence, the acid test, is still wanting that there is a significant lack of vitamin A in a fairly well-balanced occidental diet, and it is beclouding the issue to assume that an inadequate supply of vitamin B plays more than a relatively insignificant part in the amazing incidence of anorexia in childhood, which every pediatrician knows is almost wholly on a psychologic basis. That an adequate intake of calcium and phosphorus from milk and vegetable products and the assurance that they will be utilized advantageously through an ample supply of vitamin D from sunshine, ultraviolet rays from an artificial source or cod liver oil and analogous sources is of prime importance in the building of sound and enduring teeth and bones and other tissues seems demonstrated. Hanke's[1] wide investigation on the effect of an intake of enormous amounts of orange and lemon juice on dental caries and gingivitis, in spite of the fact that it has not fully met the requirements of some of our scientific allies, nevertheless leaves one with the idea that large amounts of vitamin C, or at least of fresh citrus juices, have an inhibitory effect on these pathologic processes. Foods having an alkaline ash are considered of importance by some and other dietetic features may play a rôle. New discoveries are reported daily.

We are still in a confused stage of advance in a new and complex domain. It would seem well to await the outcome patiently and conservatively—two desiderata in medicine—adhering in the meantime to what we know is good and not going too far afield after strange gods. Peculiarly interesting and simple, in view of the foregoing remarks, is the work of Boyd, Drain and Nelson.[2] As you will recall, they have reported that they were able both to prevent and to arrest dental caries by simply placing the child, under rigid control, on a well-balanced diet of natural foods, milk, vegetables, meat, cereals, citrus fruits and cod liver oil, without any recourse to the use of high concentrates, whether of vitamins or of minerals. The work of Bunting and his co-workers[3] points toward the same conclusion.

I am not, of course, belittling the importance of the toothbrush, of the reaction of the saliva and of periodic dental examination and care. That is axiomatic. It has been my impression that, at least in the past, dentists, like physicians, have too often been more occupied with the repair of damage than with its prevention.

One of the most discussed and confusing aspects of mouth infection has to do with the Plaut-Vincent fusospirochetal complex. It is commonly diligently sought for, usually found and is then given pathogenic significance. It may be interesting on this occasion to recall that an American dentist, Willoughby D. Miller, described these organisms as early as 1883, nine years before Plaut's[4] and thirteen years before Vincent's[5] reports

1. Hanke, M. T.: Diet and Dental Health, University of Chicago Press, 1933.

2. Boyd, J. D., and Drain, C. L.: Arrest of Dental Caries in Childhood, J.A.M.A., 90: 1867-1869 (June 9) 1928; Boyd, J. D.; Drain, C. L., and Nelson, M. T.: Dietary Control of Dental Caries, Am. J. Dis. Child., 38:721-725 (Oct.) 1929.

3. Bunting, R. W., et al.: Problem of Dental Caries, Am. J. Dis. Child., 40:536-548 (Sept.) 1930.

4. Plaut, H. C.: Studien zur bacteriellen Diagnose der Diphtherie und den Anginen Deutsch. med. Wchnschr., 20:920, 1894.

5. Vincent, M. H.: Recherches bacteriologique sus l'Angine á Bacillus Fusiformis, Ann. l'Inst. Pasteur, 13:609, 1899.

were published. Plaut called them "Miller's organisms" and Miller in turn stated that, even before his own report, Verneuil and Clado had ascribed pathogenic properties to them. Weaver and Tunnicliff[6] cultured the organisms from cases of ulcerative stomatitis but were unable to produce any lesion in animals with them. Tunnicliff[7] later expressed the view that the fusiform bacillus and the spirillum represented a single pleomorphic organism. This has not been widely accepted.[8] The organisms have been quite generally assumed to be the active agent in such mouth conditions as ulcerative stomatitis, acute and chronic gingivitis and stomatitis, "trench mouth," so-called Vincent's angina and possibly noma; and in inflammatory lesions of the mucus membranes of the genitalia, and to play an accessory part in some cases of bronchiectasis and lung abscess and gangrene. It has been reported to occur as the significant agent in foul-smelling abscesses, even in one brain abscess. This assumption has always seemed to me to rest on dubious grounds.

Two questions naturally arise: Has it been demonstrated by the usual bacteriologic procedures that the Plaut-Vincent organisms have pathogenic properties; and, as a natural corollary, does their mere presence in diagnostic smears, even in great numbers, indicate a pathogenic relationship to a lesion that is under suspicion?

The answer to the second question is simple: It does not. I shall assume that the reasoning on which this conclusion is based will become evident from what follows. The answer to the first question is hemmed about with difficulties that make it all but impossible to find the answer. In spite of the fact that the organisms can be grown in pure culture, it has never been demonstrated that they alone can be incriminated as pathogens. No one has ever claimed to be able to set up any morbid process with the organisms in pure culture unless they were combined with other germs. If the organisms are transplanted to an abraded mucus membrane such as the gums, and they persist, probably even multiply, this fact cannot be accepted as evidence of a pathogenic relationship, since an identical condition follows, as we shall see, the mere abrasion with a sterile instrument without such transplantation. In other words, the organisms are found with great regularity whenever there is a lesion of nearly any kind on an accessible mucus membrane, often enough without evidence of such a lesion.

Various reports have placed the occurrence in normal mouths at around 50 per cent. Kline[9] was able to produce gangrene and foul-smelling pus in animals after traumatizing the affected muscles and injecting material from cases of gangrene of the lungs, Vincent's infection, carious teeth and pyorrhea. Smith[10] did the same, and also produced a like result without traumatization when the animal was brought to the bedside with a minimum exposure of the infectious material to the air. Gangrene of the lung and lung abscess were produced in a number of instances by both Smith and Kline after intratracheal injection of such infectious

6. Weaver, G. H., and Tunnicliff, Ruth: Occurrence of Fusiform Bacilli and Spirilla in Connection with Morbid Processes, J. Infect. Dis., 2:446, 1905.

7. Tunnicliff, Ruth: Identity of Fusiform Bacillus and Spirilla, J. Infect. Dis., 3:148, 1906; Further Studies on Fusiform Bacillus and Spirilla, ibid., 8:316, 1911.

8. Krumwiede, Charles, Jr., and Pratt, Josephine S.: Fusiform Bacillus—Cultural Characteristics, J. Infect. Dis., 13:438, 1913.

9. Kline, B. S.: Experimental Gangrene, J. Infect. Dis., 32:481 (June) 1923.

10. Smith, D. T.: Experimental Aspiratory Abscess, Arch. Surg., 14:231 (Jan.) 1927.

material. It is obvious that even these results do not as yet necessitate the assumption that the fusospirochetal organisms, in such mixed company, played a rôle in pathogenesis. One may as well assume that they are saprophytic opportunists that thrive like the buzzard and the maggot wherever there is death or destruction, that their presence may be a result instead of a cause of the disease. It is, moreover, a far cry from foul-smelling subcutaneous abscesses and gangrene and abscess of the lung to the superficial lesions in the mouth that are our more immediate concern at this time. Still later reports of Smith,[11] if confirmed by further observations, may throw a new light on the subject. These will be considered later.

Having always doubted, for reasons that would seem obvious from what I have said, that these organisms had a relationship to the many and varied diseases to which such relationship was commonly attributed, I deemed it worth while to probe into the matter. As a result, a rather extensive investigation was made at the Children's Memorial Hospital by Dr. Lichtenberg, Miss Werner and Miss Lueck.[12] I shall quote freely from their report, at times verbatim. I hope it may prove interesting, perhaps even stimulating to observation along similar lines. It is not presented in any way as conclusive. If it will add to the confusion that already exists, it will perhaps have served a useful purpose.

The organisms were grown in pure culture. All attempts to produce abscesses even when the tissues were crushed or injected with boiling water were unsuccessful.

Since, as already stated, these organisms are found with great regularity in nearly all pathologic lesions in the mouth, even on what seems to be normal mucus membrane, it was thought to be of interest, as of possible significance, to see what would be found in recent wounds made with sterile instruments, both in the human and in the experimental animal mouth. Recent tonsillectomies furnished readily available human material. In 108 children whose tonsils had been removed, the organisms were found in smears from the excised tonsils themselves in 46 per cent of the patients. In 78 per cent of the 46 per cent of children, the fusiform bacillus alone; in 20 per cent, both organisms were found. In 12 per cent, they occurred in such numbers that, by conventional standards, a diagnosis of Vincent's infection would have seemed justified as far as the smear was concerned. On the other hand, the organisms were found in 91 per cent of the smears from the membranes covering the tonsil beds four or five days after the operation. In 50 per cent, only the fusiform bacillus; in the other 50 per cent, both bacillus and spirillum were found. It is probably safe to assume that more nearly, if not indeed quite, 100 per cent of the tonsil beds would have yielded the organisms if one could have disregarded the danger of inducing hemorrhage and could have proceeded with the same thorough and carefree technic with which they were obtained from the excised tonsils. In smears from thirty-one of the tonsil beds, relatively few organisms were found; in 17 instances they were so numerous that, again, a diagnosis of Vincent's infection might seem justified from the smears. Six of the patients had a rather stormy convalescence. Of those, two showed many

11. Smith, D. T.: Fusospirochetal Disease of Lungs Produced with Cultures from Vincent's Angina, J. Infect. Dis., 46:303 (April) 1930; Oral Spirochetes, Baltimore: Williams and Wilkins Co., 1932.

12. Lichtenberg, Henry H.; Werner, Marie, and Lueck, Esther V.: Pathogenecity of Fusiform Bacillus and Spirillum of Plaut-Vincent, J.A.M.A., 100:707-711 (March 11) 1933.

and four only a few fusospirochetal organisms in the smears from the tonsil beds. That abnormal conditions in the mouth had no bearing on the number of organisms found in the smears from the postoperative membranes was evidenced by the fact that twenty-seven of eighty patients carefully examined in that respect, who had apparently normal gums and teeth, showed many organisms. Of "seventeen patients with very many organisms in the smears from the membranes, nine had apparently normal gums and teeth, while only eight had some abnormal condition." It was further noted that there was "no constant relationship between the intensity of the injection surrounding the tonsillar fossae or the number of pus cells seen in the smears and the number of Vincent's organisms."

Smears were made from the normal gums of nine guinea-pigs, with negative results in all instances. Under ether anesthesia, the lower gum was then abraded with a sterile scalpel in each guinea-pig until a bleeding ulcer was produced. Three days later, in every instance, many fusiform bacilli and spirilla were found in smears from the dirty gray membranes that covered the ulcers. "These were indistinguishable from those obtained from the human subjects and had the same cultural characteristic as those recovered from the spongy gums of human mouths." In about a week, the lesions were clean and newly healed, but the organisms were still abundant. About the twelfth day the lesions were fully healed, and the organisms were not found about two days later.

In recent years, the arsenicals, by intravenous, intramuscular and oral administration, and by topical application in superficial lesions, have gained a leading vogue in the treatment of ulcerative stomatitis, Vincent's infection and noma, as well as in bronchiectasis, lung abscess and lung gangrene in which smears from the foul-smelling expectorated pus contained the fusospirochetal organisms. We are all familiar with the specifics that have come and had their day, all of which have had a significantly like effect if one may judge from the reports of their proponents. It is a common observation that if there are many remedies for a disease, they are either nearly all of some value, or else the disease runs a natural self-limited course; usually the latter. In the present instance, it is instructive to enumerate some of the many such remedies that have been vaunted as valuable therapeutic agents: locally, the application of tincture of iodine, chromic acid, glycerine, formaldehyde, potassium chlorate, sodium perborate, acriflavine, copper sulphate, methylene blue, gentian violet, mercurochrome and hexylresorcinol and freezing with ethyl chloride and arsenicals; internally, vitamins B and C and stovarsol therapy; by injection, antimony and potassium tartrate and arsenic derivatives. It is interesting, in view of the striking therapeutic results that are said to follow the use of the arsenicals, that the organisms have been found about the gums and in gingival ulcerations, in syphilitic patients while under antisyphilitic treatment and that Donson,[13] Sutton,[14] Williams[15] and Hillsman and Driscoll[16] have reported the occurrence of acute Vincent's infection in patients under active treatment for

13. Donson, S. D.: Vincent's Infection Contracted During Luetic Treatment, D. Cosmos, 75:883-883 (Sept.) 1933.

14. Sutton, I. C.: Vincent's Angina Occurring in Patient Under Treatment for Syphilis, J.A.M.A., 83:1919 (Dec. 13) 1924.

15. Williams, G. A.: Vincent's Angina: Case Occurring During Antisyphilitic Treatment, Arch. Derm. & Syph., 20:322 (Sept.) 1929.

16. Hillsman, J. A., and Driscoll, T. L.: Fusospirillary Infection Which Developed During Active Arsphenamine Treatment, Virginia M. Month., 52:312 (Aug.) 1925.

syphilis and presumably fairly saturated with the drug. Lichtenberg, Werner and Lueck injected four of a group of eight guinea-pigs intraperitoneally with 25 mg. of sulpharsphenamine per kilogram of body weight on alternate days for four doses. No organisms were found before the injections were given. Ulcerations were then produced as in the previous experiments in all of the eight animals. Smears were made every other day and the sulpharsphenamine was continued in the four pigs already injected. In a second series of six guinea-pigs whose gums had been abraded in like manner, the ulcers in three were painted with a 10 per cent solution of sulpharsphenamine, while those of the other three were painted with physiologic sodium chloride solution as controls. "In all animals a membrane formed over the ulcerations, and fusospirochetal organisms were found in all of them. The lesions in the animals treated with sulpharsphenamine healed at the same rate and organisms remained as long as in the control animals."

Of special interest in this connection, both to the dentist and the physician, is that group of pathologic mouth conditions variously designated as both acute and chronic gingivitis, ulcerative gingivitis, ulceromembranous gingivitis, Vincent's angina and, on the assumption that the Plaut-Vincent's organisms are the causal agents, Vincent's infection. I confess to an embarrassing confusion in my own mind as to the etiology, pathology and clinical significance of the conditions so designated. From your dental literature, I glean the impression that there is like confusion in your own ranks. I think much of this is due to the fact that we do not all speak the same language, or even see the same thing. It is my impression that both the acute and the chronic conditions that seem to play so important a part in dentistry are not the same things with which the pediatrician is so familiar. My own confusion begins in the fact that, in my earlier days, we not infrequently encountered a condition to which the term "ulcerative gingivitis or stomatitis" was restricted, which was characterized by an inflammatory swelling and sponginess of the gums, which bled easily, always exhibited ulceration on the dental margins and had an odor so foul that the condition could be diagnosed at a distance, and the fact that it is now many years since I have seen, or rather smelled, one of those once well-known entities. If Vincent's infection, or a fairly obvious and bothersome acute or chronic gingivitis, other than in association with an evident throat infection, has occurred in any degree of frequency among my patients, then I have been a poor observer. I am in no way questioning what the dentist sees, but I am all at sea in explaining to my own satisfaction the apparent discrepancy. On the other hand, I have seen literally hundreds of cases of acute gingivitis and stomatitis showing swollen, bleeding, painful gums and gingival and buccal ulceration, in practically every instance easily interpreted as an extension, or at least an accompaniment, of a very evident infection in the throat. These children are sick, have a fever that is often high, and, therefore, probably rarely, if ever, come under the observation of the dentist. Or is it possible that they do, and that looking at the same thing from different angles may lead to different interpretations? At any rate, they cannot be excluded from consideration in this connection.

These lesions heal quite regularly in from four days to a week, running a course more or less concurrent with the infection in the throat. For many years, I have let them heal without any treatment, local or internal, except to give some acetylsalicylic acid for comfort and

to suggest the use of cold instead of warm or hot foods because less painful. Some of my colleagues have used each his favorite remedy, with the conviction that the same prompt recovery was due to its antifusospirochetal properties. Reliable statistics are here more convincing than my mere statement of impressions. Lichtenberg, Werner and Lueck carefully followed the course of sixteen consecutive severe cases of this type without treatment of any kind except to promote comfort to both mother and child by the use of acetylsalicylic acid. In one instance, the lesions had been painted with mercurochrome; in another a dilute peroxide gargle or mouth wash had been used; both before the patients had been referred for special observation. To quote from their report:

> Smears made from the lesions usually showed a great many fusiform bacilli and spirochetes, occasionally only bacilli, and in only two children, both under two years of age, no organisms were found. Both of these children fought desperately, and forcing the mouth open caused such bleeding that satisfactory smears were not obtained. The course of the disease was so nearly alike in all cases that, after seeing six or seven of them, we could with a fair amount of assurance advise the parents that the child would feel better in two or three days and be entirely well in a week. . . . The children were all well in from four to seven days.

It is significant that this duration occurs with stereotyped regularity in nearly all medical reports that deal with favorite remedies. It is interesting in this connection to quote two dental authorities, Cobe and Grace.[17] In discussing the treatment of Vincent's infection, they say:

> Each investigator seems to have his own favored method which produces cures. One careful operator does not use any medication. His treatment consists of the careful removal of the tartar and slough and liberal washings with warm normal salt solution. His results are notably good.

When I combine this with the emphatic statement of Tishler[18] that there is no such thing as subacute or chronic Vincent's infection, that it is always acute, I am just a bit perplexed as to where we stand as to both etiology and treatment, especially in the light of what I have just said. My perplexity, and I might imagine yours, is not lessened when I quote Rosenthal's[19] paper on Vincent's infection, acute, subacute and chronic, in which he says: "Some years ago, I stated that Vincent's Infection was entirely an acute process. . . . Today more than 60 per cent of my cases are subacute or chronic."

I am, of course, in no position to appraise the relative authoritativeness of your dental writers, but that does not detract from the conclusion that what is written represents a cross-section of current conventional ideas, and that these reveal what I take to be a wholesome variance of opinion on a problem that is still in a state of flux as I see it. One thing you nearly all seem agreed on, the causal relationship of Vincent's organisms to these lesions, and that is at present our chief concern. It is interesting to note that Tishler,[18] apparently an authoritative periodontist, has a somewhat different slant on the subject when he says: "It is commonly believed that the spirochete and fusiform bacilli are primary etiologic agents. Practitioners are unaware that these are saprophytes and multiply only after a primary infectious organism has lowered the tone of the affected cells." The "primary infectious

17. Cobe, H. M., and Grace, L. G.: Ulceromembranous Gingivitis, D. Cosmos, 73:461-467 (May) 1931.

18. Tishler, Benjamin: General Practitioner's Misconception of Vincent's Infection, D. Cosmos, 78:178-180 (Feb.) 1936.

19. Rosenthal, S. L.: Vincent's Infection—Acute, Subacute and Chronic, J.A.D.A., 20:438 (March) 1933.

organism" is apparently a streptococcus. Just what his idea of Vincent's infection is is not clear in my mind, but I take it that he does believe that the fusospirochetal organisms, as secondary invaders in a previously prepared field, have pathogenic properties that determine the clinical picture of what he calls Vincent's infection. He lays special emphasis on cell tone as promoted by use of the toothbrush and the general state of health in the prophylaxis of the primary gingivitis and considers "the presence of ulceration as a necessary diagnostic sign of Vincent's infection." We are left with an assumption, not a demonstration of pathogenesis such as the bacteriologist requires. We still have only two of Koch's four postulates fulfilled.

In 1930 and 1936,[11] Smith reported observations that, if confirmed, may throw light on the subject. He presents evidence that Vincent's organisms by themselves are not demonstrably pathogenic, but that, if associated with several other organisms, they do contribute to the production of foul-smelling abscesses when injected into guinea-pigs. He isolated four anaerobic organisms in pure culture, the fusiform bacillus and spirochete, a vibrio and a hemolytic streptococcus. No combination of any less number than all four of these when injected into a guinea-pig could be made to produce a typical foul-smelling abscess.[20] He has reported their occurrence, invariably so combined, in all of the lesions discussed in this paper. A facultative symbiosis of four organisms is a bit startling and at least invites further investigation and confirmation. Even then, does it necessarily inculpate Vincent's organisms as other than saprophytes who feed and thrive on what others have prepared and thereby contribute the foul smell? It is a common surgical procedure to inject arsenicals into patients with foul expectoration from lung abscess and gangrene and bronchiectasis if smears show fusiform bacilli and spirochetes, and the results are claimed by many as specific. Claims in which control is impossible are always open to question. Too, it is a long way with few points of contact from the experimental subcutaneous abscess, bronchiectasis, lung abscess and gangrene to the mouth infections that are our present concern.

I am offering no conclusions. I am questioning, but I do venture the opinion that in our present state of knowledge the assumption that Vincent's organisms, even though found beneath the surface, have other than a saprophytic, even much less a primary etiologic relationship to the many and varied lesions with which they are so commonly associated, is based on clinical impression and tradition in practice and not on such bacteriologic demonstration as is conventionally required to establish a specific pathogenesis. Even more, I hope it will at least be evident why I feel justified in questioning the diagnostic significance of the mere presence of the organisms, even in great numbers, in smears from a suspected lesion. Tishler[18] quite emphatically supports this latter view and quotes Lichtenberg[12] in that connection. All of this may seem to have the appearance, even the significance, of didactic quibbling without any relation to practice; and yet precision in scientific knowledge is always followed by useful repercussions in practice. Least of all would I want to seem to presume to pass judgment on your therapy or to influence it by one iota. I might say that, as we know so well in medicine, if one never departs from a favorite remedy to which one attributes results, one can never learn what Nature alone will so often accomplish. It is also a well known dictum in medicine that the much exposed mouth

20. Footnote 11, first reference.

has a wide and powerful range of immunity against infections.

Before leaving this subject, I wish to report that following the publication of the paper by Lichtenberg and his coworkers,[12] two of your colleagues sent a blast so vitriolic to the correspondence department of *The Journal of the American Medical Association* that *The Journal* would not publish it in its original form. I throw myself on your mercy. On the other hand, it was recently reported to me that a dental bacteriologist has said that the whole subject of Vincent's infection was due for a "shake-up." It is well to keep an open mind and, especially, to await critical judgment on the evidence presented by Smith.[21] It, at least, presents a persistent and constructive attempt to solve the problem.

Other local infections in the mouth can be discussed more briefly. I do not know what causes canker sores or whether they have anything to do with infection. Perhaps they are a form of herpes. I am not convinced that they are the result of stomach or intestinal trouble. Halitosis is at least largely due to infection and lack of hygienic care of the mouth. Decomposition of food deposits between the teeth probably plays an important rôle. It has been attributed to a somewhat analogous condition at the base of the tongue. It is said that the Chinese use a hoelike instrument to scrape away the offending deposits. The toothbrush serves well for the same purpose. Halitosis occurs also in acute stomach upsets, in fevers and in all conditions accompanied by coating of the tongue.

The pediatrician rarely encounters pyorrhea. He is quite familiar with alveolar abscesses. Not so infrequently, he encounters swelling of the jaw and that submental, never cervical, adenitis and cellulitis that result from an apical abscess. He is quite in accord with the view that the abscess should be drained early to avoid the danger of extensive cellulitis and even more of osteomyelitis of the mandible, and that drainage should be intra-oral whenever possible. Whether the offending tooth should always be extracted seems open to question. When osteomyelitis of the mandible does occur, there is apparently increasing agreement that after the acute process subsides, one should wait for full sequestration before operation is undertaken. If suppuration occurs secondarily to lymphadenitis, it is wiser not to drain too early. A smaller scar, less psychic trauma to the child and more rapid healing result if that policy is pursued. Such suppuration should rarely occur if the primary abscess is drained early enough.

Noma is a gangrenous affection beginning on the mucus membrane at the angle of the mouth and progressively invading and destroying the whole cheek and adjacent structures. It is a rare disease. I have seen only four or five cases. It is nearly always fatal. Only once have I seen what seemed a noma that progressed about an inch or more and then subsided, leaving me in doubt as to its real nature.

There is one other type of infection that interests us keenly. More than in almost any other condition, we dread, and try to avoid, postoperative infections in cleft palate and harelip patients. We set aside two separate wards for such cases at the hospital, and often suspend all except emergency operative work during epidemic peaks of throat infection. We also try to make sure that the child is free from infection at the time of operation.

Finally, a brief consideration of the relationship of dental infections to systemic disease is in order. Here, the physician should be in a more advantageous position to evaluate cause and effect than is the dentist. The latter is in somewhat the

21. Footnote 11, second reference.

same situation as is the otolaryngologist who removes a child's tonsils and adenoids and is quite shut off from that further knowledge of the therapeutic result which is a part of the experience of the family physician or pediatrician, both before and after the operation. The effect on the systemic condition that follows the removal of a suspected local condition is naturally the most available and evident criterion by which to judge an etiologic relationship. Some of the more glowing reports, both medical and dental, too often given one the impression of being based on tradition and hearsay rather than on experience.

The situation is not so simple and evident. A child with a mouth full of carious and infected teeth is not going to eat normally and will suffer nutritionally. Whether this is due to tactile or thermal hypersensitiveness, to malocclusion with resulting inadequate mastication or to absorption of toxins matters little—the result is much the same. It must be remembered that the state of nutrition and the condition of the teeth may more probably be due to a basic dietetic and hygienic situation that is common to both.

It is obvious that infection in a tooth or some other oral infection may give rise to septicemia, as any other focal infection may. In my experience, this is extremely rare, infinitely rarer than with infections in the throat and its adnexa. One still hears loose talk about rheumatism as a complication of, or sequel to, dental infection. There is not one shred of evidence to support this view. One may, indeed, find arthritis, perhaps even carditis, as a complication, but that is not rheumatism. Rheumatism is *sui generis,* being constant in its clinical manifestations so that there can be no doubt that it is due to a specific organism, even though its exact identity is unknown. The arthritis of rheumatism disappears overnight with the administration of salicylates; the other arthritides remain practically untouched. The cardiac condition in rheumatism is almost invariably chronic and permanent; that due to other acute infections, with few exceptions, is followed by full recovery or by death. In the etiology of nephritis, dental infections are practically negligible as compared with other infections.

There remains the matter of "focal infection," in the sense in which it was used a decade or two ago when it was at its height; i. e., the distant, or systemic effect of a chronic, often slumbering, focus of infection. Many of you will recall some of your friends or patients who had some or all of the teeth extracted, tonsils and appendices removed, sinuses and gallbladders drained, intestines purged and colons irrigated, all in quest of an often elusive focus of infection that might be incriminated as a cause of some systemic disease. The most common of these was arthritis, usually subacute or chronic, local or general, and the most frequent offender an apical abscess because there are so many of them and they are so easily attacked. I am not for a moment questioning the fact that a focus of infection may be responsible for some distant or systemic manifestation. I speak as a pediatrician and what I say has no bearing on the situation as it reveals itself in the adult. If the presence of infected teeth, apical abscesses, is a common cause of chronic arthritis, or any arthritis, in children, removal of the focus should lead to fairly uniform and definite results; at least, to an arrest of the condition if instituted early. If it does, I am, again, a poor observer. I have seen many cases of chronic arthritis in children, so-called arthritis deformans, and, much more rarely, a true Still's disease. I have yet to see one cured or permanently arrested by dental measures alone. Perhaps there is a bacterial invasion of the peri-

articular structures themselves; perhaps one ought not to expect established anatomic changes to recede. And yet we know that they do at times. In one instance, a boy with marked involvement of nearly all of his joints of several years' duration apparently recovered completely and is still well. He had infected teeth, which were adequately treated. He had also a chronic and recurrent bilateral mastoiditis. He also had special attention given his diet and matters of hygiene and was injected with vaccines from several sources. The preponderance of evidence seemed to point to the fact that he seemed to begin to get better after the mastoid condition was cleared up. Perhaps he would have gotten well anyhow. It is, of course, axiomatic that full dental care should be given to all these patients and to all children.

I hope I have presented evidence as to why there should be a close and sympathetic cooperation between the dentist and the physician. We are trying to have that at the Children's Memorial Hospital. We hope to do much more in the future. There is much that we have in common, much that we can and should learn from one another. It would profit both us and our patients.

707 Fullerton Avenue.

CULTURAL STUDIES OF ORAL FUSOSPIROCHETOSIS CORRELATED WITH THE GINGIVAL EXUDATE AND CLINICAL MANIFESTATIONS*

By RICHARD D. DEAN, B.S., D.D.S., M.D., and MARGUERITE T. DEAN, B.S., M.D., Memphis, Tenn.

OUR previous reports on this subject[1] have attempted to establish a correlation between observations of the fresh material and of cultures from oral lesions clinically diagnosed Vincent's infection. The terms Vincent's infection, fusospirochetal infection and trench mouth convey to the clinician an infectious process caused by spirochetes and fusiform bacilli. Bacteria having such structure are spoken of as Vincent's organisms. Stained smears of the gingival exudate in which spirochetes and fusiform bacilli are present are also always characterized by other bacterial forms, such as coccoid, comma and filamentous. It has consistently been our observation that the proportions in which these different morphologic bacterial species predominate vary, not only in different mouths and in various areas in the same patient's mouth, but also from day to day in the same lesion.

In the present study, we have obtained specimens from lesions in which not more than one or two bacterial forms predominated, recorded the clinical manifestations, endeavored to isolate the predominant bacterial forms in pure cultures, and pointed out certain common associations. We have limited the cultural environmental conditions, employing a method of anaerobiosis that permitted a

*From the University of Tennessee, College of Dentistry.

1. Dean, R. D., and Dean, Marguerite T.: J. D. Res., 11:747-758 (Oct.) 1931; ibid., 11: 759-770 (Oct.) 1931.

convenient daily observation of the culture tubes. A review of the literature will not be given here since our previous papers have included one. A most complete list of references on Vincent's infection has recently been compiled by Appleton.[2]

TECHNIC OF OBTAINING THE INOCULUM

Specimens of exudate were taken from each of ten different parts of the gingivae; i. e., from the interproximal spaces in the four molar regions, from the four bicuspid and cuspid areas and from the regions of the upper and lower anterior teeth. The exudate was secured with a small platinum loop, which was inserted under the gum margin as far as it would go or to the bottom of a pocket when one was present. We were careful to avoid getting material from the surface of the teeth or of the gingivae. The technic insured the obtaining of bacteria from a natural habitat of anaerobiosis. The exudate was spread in a small drop of distilled water on a clean glass slide, allowed to air dry, fixed in heat and then stained, routinely, with gentian violet, as we have found no variation in the staining reactions from the results that we have already reported.[3] The stained films of exudate were then carefully studied under the microscope. Table 1

TABLE 1.—BACTERIOLOGIC FINDINGS ON THE GINGIVAL EXUDATE*

Name Case E	Clinical Case Number 2861			Laboratory Register Number 1196		Examination Number 1			Date 4-1-1935	
Bacteria	Up. Rt. Molar No. 1	Up. Rt. Cuspid No. 2	Upper Anterior No. 3	Up. Lt. Cuspid No. 4	Up. Lt. Molar No. 5	Lo. Rt. Molar No. 6	Lo. Rt. Cuspid No. 7	Lower Anterior No. 8	Lo. Lt. Cuspid No. 9	Lo. Lt. Molar No. 10
Spirals	Very Few	No	No	No	No	Few	No	No	No	Few
Bacilli	Few	Few	Few	Many, slender, pointed	Same as area 4	Few	Few	Few	Few	Few
Cocci	Few	Few	Few	Few	Few	Few	Few	Few	Few	Few
Filaments	No	Few	No	Few	Few	Very few	Very few	No	Very few	Few
Commas	No	No	No	No	No	Few	Few	No	No	Few
Motility	†			Bacilli non-motile	Bacilli non-motile					

*In areas 1, 2, 3, 6, 7, 8, 9 and 10, the bacterial flora were few and very little exudate was present. In areas 4 and 5, a definite pocket was present containing considerable exudate. Cultures were made from areas 4 and 5.

†No dark-field examination was made.

2. Appleton, J. L. T., Jr.: Bacterial Infections, Ed. 2, Philadelphia: Lea & Febiger, 1933, pp. 528-595; D. Çosmos, 1929, 71:576 (June) 1929.

3. Footnote 1, second reference.

shows the form upon which the observations are routinely charted.

Second and third specimens were next obtained from those areas that promised interesting results from the standpoint of culture or of study of motility under dark-field illumination. The stained specimens of exudate were carefully labeled and filed for a comparative analysis with later specimens from the corresponding culture. For example, areas 4 and 5 in Case E (Table 1) record apparently a pure culture of a slender pointed granular fusiform bacillus in the natural habitat. A study of the findings indicated for the other areas will show that areas 4 and 5 were by far the most interesting

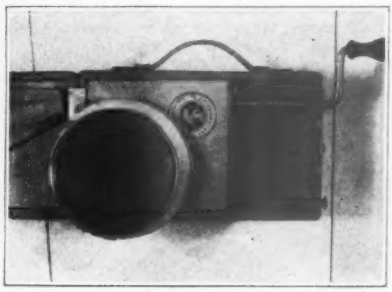


Fig. 1.—Improvised spiral streak method equipment. A pocket phonograph is used. The record disk is built up to a flat surface with a piece of corrugated cardboard. The needle holder arm has been removed. The plate to be inoculated is centered on the cardboard disk and the machine is wound. The disk is then released, and as it begins to revolve, the top of the petri dish is removed. The platinum loop containing the inoculum is placed in contact with the medium at the periphery of the plate. The hand holding the inoculated loop is held perfectly still, and as the disk revolves, the loop gradually works to the center of the plate, just as the needle does on a phonographic record. Plates streaked by this method will grow well-isolated colonies on the inner concentric streaks.

from a standpoint of further investigation. In other cases, there was little, if any, difference between any of the ten areas as the entire gingivae was involved with a marked mixed infectious process.

CULTURAL METHOD

Our previous cultures[3] were made in fresh veal infusion-brain broth and on blood-agar plates, and grown anaerobically by the use of the phosphorus jar[4] or of Wright's alkaline-pyrogallic acid method. The recent literature reveals some newer mediums and methods of anaerobiosis for the isolation of anaerobic bacteria. Knighton and Bibby,[5] in 1933, reported that by using blood-agar and hydrogen anaerobiosis, isolation of fusobacteria (fusiform bacilli) from the mouth was relatively simple, and that the addition of gentian violet to blood or potato-extract mediums (Slanetz) rendered them somewhat selective for fusobacteria. Hartzell and Rettger,[6] in 1934, used an egg-meat medium, cysteine-meat infusion broth and basic cysteine-meat infusion-agar in a toxonomic study of the anaerobe *Clostridium putrificum*, and its establishment as a definite entity. Livesay,[7] in 1933, used 0.5 lithium chloride broth and modified Veillon agar in dissociation studies of the anaerobe *Clostridium welchii*. We elected to use, in our investigation of mouth anaerobes, Slanetz's[8] potato extract medium; first, because its ingredients are readily available, and, secondly, because of the reported ease with which the fusobacteria were isolated on this medium without the addition of any body fluid.

4. Varney, P. L.: Am. J. Pub. Health, 19: 1248-1249 (Nov.) 1929.

5. Knighton, H. T., and Bibby, B. G.: J. D. Res., 13:204 (June) 1933.

6. Hartzell, S. E., and Rettger, L. F.: J. Bacteriol., 27: 497-515 (May) 1934.

7. Livesay, H. R.: J. Infect. Dis., 53:125-137 (July-Aug.) 1933

8. Slanetz, L. W., and Rettger, L. F.: J. Bacteriol., 26:599-621 (Dec.) 1933.

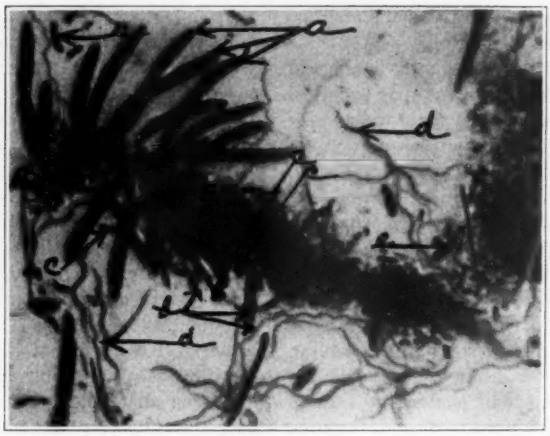


Fig. 2.—Lateral radiation of fusiform bacilli; from a spread of exudate stained with gentian violet. *a*, large bacilli; *b*, smaller bacilli; *c*, coccoid forms; *d*, spirochetes; *e*, comma forms. (×1200.)

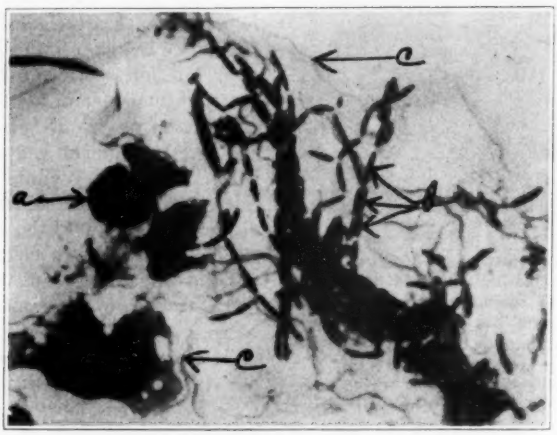


Fig. 3.—Parallel rows of seed-stitch formation of fusobacteria; spread of exudate stained by gentian violet. *a*, pus cell; *b*, seed-stitch formation; *c*, spirochetes. (×1200.)

Many of the methods for maintaining anaerobiosis that are in use, such as the phosphorus jar and the alkaline-pyrogallic acid method, previously mentioned; the alternate exhaustion of a jar with a vacuum pump and rinsing with pure carbon dioxide[8]; the use of the McIntosh and Feldes anaerobic culture jar, used by Wyckoff,[9] the jar operating by the com-

9. Wyckoff, R. W. G., and Smithburn, K. C.: J. Infect. Dis., 53:201-209 (Sept.-Oct.) 1933.

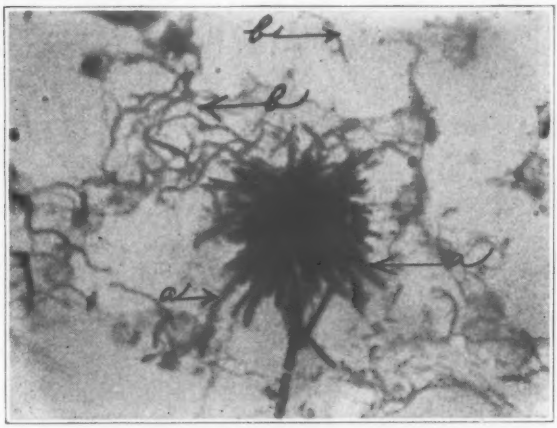


Fig. 4.—Cocklebur formation of fusobacteria, a slender fragile species. From a spread of exudate stained by gentian violet. *a*, fusobacterium with intracellular granules; *b*, spirochetes. (×1200.)

Fig. 5.—Fusobacteria in seed-stitch formation, radiating from a central stalk or axis. From a spread of exudate stained by gentian violet. *a*, pus cell; *b*, fusobacteria in seed-stitch rows. (×1200.)

bustion of oxygen with hydrogen under catalytic action of hot palladium-asbestos, and the use of the Reeves[10] glass tube, which is a modification of Wright's method for surface growth of anaerobes, either require expensive apparatus, are not efficient or are time consuming in the preparation required for their use. We were in search of an efficient method that would readily permit the daily observa-

10. Reeves, J. R.: J. Bacteriol., 26:471 (Nov.) 1933.

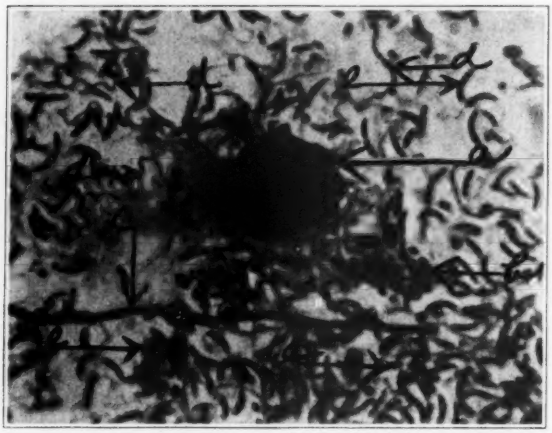


Fig. 6.—Predominance of comma forms in exudate from acute case of oral fusospirochetosis. *a*, pus cell; *b*, cluster of coccoid forms; *c*, filament; *d*, spirochetes; *e*, comma forms. (×1200.)

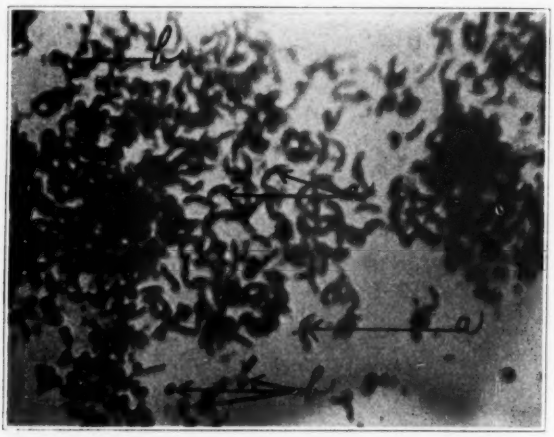


Fig. 7.—Spread from a 24-hour potato-extract gelatin culture, stained by gentian violet. *a*, comma forms; *b*, coccoid forms. (×1200.)

tion of cultures and found that the use of reduced iron[11] met these requirements.

Our method of isolation differed from that of Varney[12] and of Slanetz[8] in that we did not identify single colonies of fusobacteria on plates streaked with fresh exudate. Slanetz[8] says, "Pure cultures could, as a rule, be procured by simply picking from the original colonies on the dye-agar plates." He says further, "All cultures were plated out several times to insure their purity." We found that those

11. Scott, J. P., and Brandly, C. A.: J. Bacteriol., 26:1-7 (July) 1933.

12. Varney, P. L.: J. Bacteriol., 13:275-314 (April) 1927.

single colonies that did contain pointed bacilli in appreciable numbers were mixed with coccoid forms and frequently with filaments. We were not successful in purifying them by the plating method. In most instances, the bacilli were lost. We therefore abandoned this method and made our original cultures and transplants in 5 c.c. of potato extract-gelatin medium[8] containing gentian violet 1:20,000, sterilized over 200 mg. of reduced iron. While the dye is gradually reduced by the iron and the medium has no purple tint after twenty-four hours' incubation, its use appeared to have some inhibitory effect on the growth of the coccoids, as cultures from the same specimen showed fewer cocci in tubes containing the dye than in those without the dye.

At the end of twenty-four hours, abundant growth was present near the bottom of the tube over the iron and extended up into the same semisolid medium. Specimens of this growth were fished from all parts of the tube with a platinum loop, mixed on a glass slide and routinely stained with gentian violet. The shapes of the predominant bacteria were observed

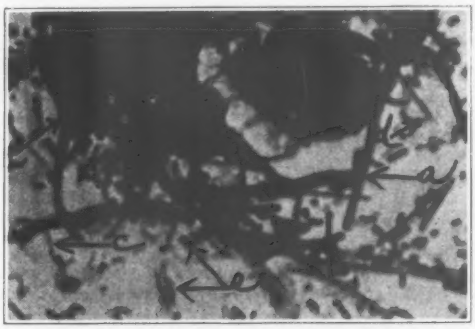


Fig. 8.—Spread from gingival exudate showing a predominance of filaments. *a*, single filament; *b*, mass of filaments; *c*, spirochete; *d*, comma form; *e*, cocci. (×1200.)

Fig. 9.—Spread from a 24-hour potato extract-gelatin culture made from exudate (Fig. 8). *a*, filament; *b*, cocci. (×1200.)

and recorded for comparative study with those recorded for the gingival exudate from which the culture was made. The five different structural types, i. e., spiral, bacillary, coccoid, comma and filamentous, were present in our first 24-hour cultures in varying proportions in marked similarity to the preponderance in which they were present in the inoculum from which the culture was made. A very heavy inoculum was then transferred to a second tube of medium. At the end of

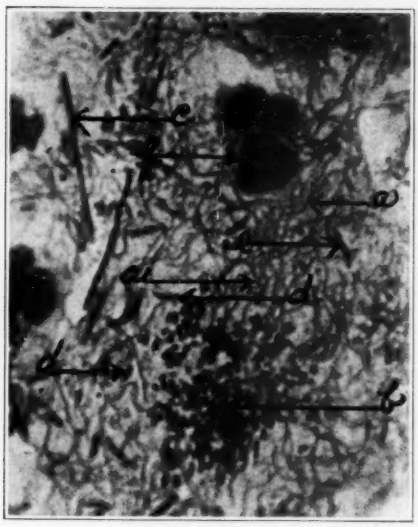


Fig. 10.—Spread from gingival exudate showing predominance of spirochetes and coccoid forms. *a*, spirochetes; *b*, cocci; *c*, short filaments; *d*, commas; *e*, fusobacterium; *f*, pus cell. (×1200.)

twenty-four hours, the contents of this second tube was not disturbed, but carefully poured into a sterile petri dish. Single clumps of bacterial growth were transferred to other tubes of medium. Similarly, successive transplants were made until what appeared to be a pure culture of a bacterial species was obtained.

A series of cultures, in which spirochetes were predominant in the exudates, were grown in potato extract-gelatin-gentian violet medium over reduced iron to which fresh sterile rabbit kidney was added to increase the growth of spirochetes. The expectations were disappointing. The medium so enriched rather promoted the growth of the coccoids, and the spirochetes were entirely lost after the third or fourth transplant. Inoculated tubes containing the rabbit tissue had each an uninoculated tube as a control, and in no instance did the uninoculated tubes show any bacterial growth. The presence of fresh tissue or the growth of the coccoid forms did not appreciably change the p_H value of the medium from its original of p_H value 7.2 to 7.6.

After a species was purified by successive transplants, potato extract-agar plates containing gentian violet dye were streaked by our improvised spiral streak method (Fig. 1) and grown in the phosphorus jar. In many instances, no growth occurred, and in no instance were we successful in obtaining surface colonies of pure fusiform bacilli. We did obtain surface colonies of pure coccoid forms on plates streaked with inoculum from what appeared to be a pure fusobacteria growing in the semisolid gelatin medium.

CORRELATED OBSERVATIONS

A series of photomicrographs were made from those preparations that are characteristic of observations of the exudate and of the cultures. There are three types of formations in which the fusobacteria frequently occur in the fresh material. We have termed these formations lateral radiation, seed-stitch and cocklebur. They are illustrated, respectively, in Figures 2, 3 and 4. We find a great variation in the size of the fusobacteria in the same preparation of the exudate. In Figure 2, the bacilli at *a*

are very much larger than those at *b*, yet they have the same structure and are radiating laterally from the same central axis. The fusobacteria are associated with large coccoid forms (*c*), spirochetes (*d*) and commas (*e*). We also find a great variation in the size of the fusobacteria present in long-standing, untreated unhygienic cases, and of those present in chronic treated cases; the former being much larger and staining so deeply as to show no granulations. Figure 2 illustrates the exudate from the former type of case. The seed-stitch formations shown in Figures 3 and 5 are also from unhygienic untreated mouths. The bacilli in this formation are sometimes very slender and sharply pointed. The bacilli in cocklebur formation (Fig. 4) are more fragile than those shown in the other two types of formation. Also, definite regular granules can be seen within the cell body in the more fragile bacilli. The bacillary forms in lateral radiation (Fig. 2) and in seed-stitch formation (Fig. 5) arise from a branch or stalk-like growth. The fusobacteria growing in artificial mediums are often smaller than those in the corresponding fresh material from which the culture was made. There is a marked similarity morphologically in the bacteria that predominate in the inoculum and in its first 24-hour culture. These findings, with the clinical manifestations in a series of illustrative cases, are presented in Table 2.

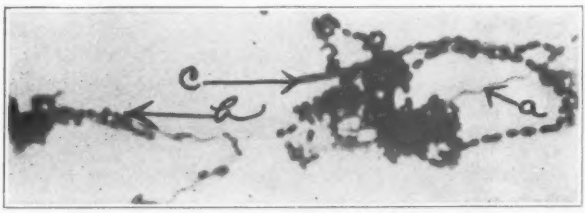


Fig. 11.—Spread from 24-hour potato extract-gelatin culture made from exudate shown in Figure 10. *a*, spirochetes; *b*, large cocci; *c*, short filament. The spirochetes have the form ascribed to Vincent's spirochete. (×1200.)

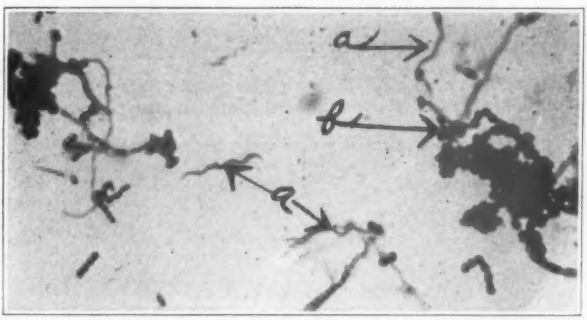


Fig. 12.—Spread from 24-hour potato extract-gelatin culture made from exudate shown in Figure 10. *a*, spirochetes; *b*, large cocci; *c*, short filament. The spirochetes have the form ascribed to Vincent's spirochete. (×1200.)

A predominance of comma forms in the exudate is illustrated in Figure 6 (Case A, Table 2). In the center is a pus cell (*a*), just below a cluster of coccoid forms (*b*), and a long filament (*c*) stretching across the field. Spirochetes (*d*) are also present, but the straight-pointed bacilli are noticeably absent. The first 24-hour culture made predominate. Attempts to isolate the comma forms resulted in the loss of them and a persistence of the coccoid forms.

In case B, Table 2, the bacterial form predominant was the filamentous one, in both the fresh material and in the corresponding first 24-hour culture, shown, respectively, in Figures 8 and 9. Filaments and coccoid forms are evident in

Fig. 13.—Spread of fifth transplant from a potato extract-gelatin culture. *a*, large coccoid forms; *b*, fusobacilli, having irregularly segmented chromatin material. (×1200.)

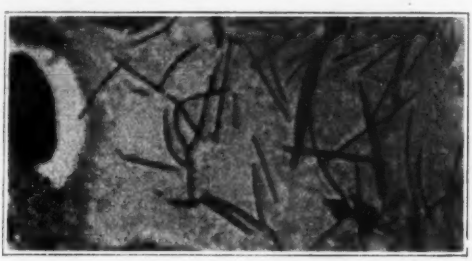


Fig. 14.—Spread of gingival exudate from Case E; spread of pure culture isolated from this specimen. (×1200.)

from the exudate from this area showed also a predominance of comma (*a*) and coccoid (*b*) forms, as illustrated in Figure 7. It is in the acute lesions of oral fusospirochetosis, occurring in young adults, that the comma forms frequently both pictures. While some spirochetes and commas were present in the fresh material, they were absent in the culture. The final transplanting from the original culture on this case resulted in only the coccoid forms. The exudate was obtained

TABLE 2.—ASSOCIATED FINDINGS ON GINGIVAL EXUDATE, CULTURES AND CLINICAL MANIFESTATIONS

Case	Bacterial Forms Predominant*		Only Forms Present	Clinical Manifestations					
	Exudate	First 24-Hour Culture	Final Culture	Type	Sex and Age (Years)	Mouth Hygiene	Pseudomembrane	Hemorrhage	Odor and Pain
A	Spirochetes, commas, cocci	Commas, cocci, no filaments, no fusobacteria	Cocci	Acute, first attack	Male, 14	Fair	Not definite, profuse exudate, all areas	Free in most areas	Foul, painful
B	Cocci, filaments	Cocci, filaments	Cocci	Chronic, long standing	Male, 35	Very poor	Present in the posterior areas	Slight in a few areas on pressure	Bad, no pain
C	Spirochetes, cocci	Spirochetes, cocci	Cocci	Acute, first attack	Male, 26	Poor	None, but gums swollen and hyperemic	Free, all areas	Bad, painful
D	Spirochetes, fusobacteria, cocci	Fusobacteria, cocci	Fusobacteria, cocci	Chronic, previously treated	Male, 45	Fair	Present in most areas	Some when gums were massaged	Foul, no pain
E	Fusobacteria, cocci, no spirochetes†	Fusobacteria, cocci, no spirochetes	Fusobacteria, with irregular granules	Chronic, previously treated	Male, 27	Good	No, scanty exudate in posterior areas	Some on pressure in posterior areas	Slight, tender
F	Spirochetes, fusobacteria, cocci	Spirochetes, fusobacteria, cocci	Fusobacteria, with regular granules	Chronic, untreated	Male, 22	Poor	Present in most areas	Free in most areas	Foul, painful

*Representatives of other forms also present, unless stated to the contrary.
†No spirochetes were revealed by either stained spreads or by dark-field examination, in areas 4 and 5 (Table 1).

from a very dirty mouth. The gingivae bled very little and the patient did not complain of a sore mouth, yet exudate could be secured from all parts of the gingivae.

Spirochetes were present in appreciable numbers in approximately 90 per cent of all original 24-hour cultures. Frequently, they were still present, but in fewer numbers, in the third and fourth transplants. In several instances, they, together with very large chain cocci, were the predominating bacterial forms in the first cultures. Figures 11 and 12 show spreads made from the first 24-hour culture which was made from the exudate referred to in Figure 10 (Case C, Table 2). The spirochetes in this case, in both the exudate and the culture, exhibited the type of structure and of motility which have been ascribed to Vincent's spirochete; i.e., average length, 6 or 7 microns; width, 0.4 microns; ends pointed from 4 to 6 curves, which form, disappear and reform as the organism crosses the field in a serpentine movement. A few spirochetes were present in the fourth transplant, but it was the large coarse cocci that persisted in further cultures. Spirochetes predominate in the exudate, frequently; in the acute type of oral fusospirochetosis, occurring in young adults; the fusobacteria being present, comparatively speaking, in few numbers.

Fig. 15.—Spread of gingival exudate from Case E; spread of pure culture isolated from this specimen. (×1200.)

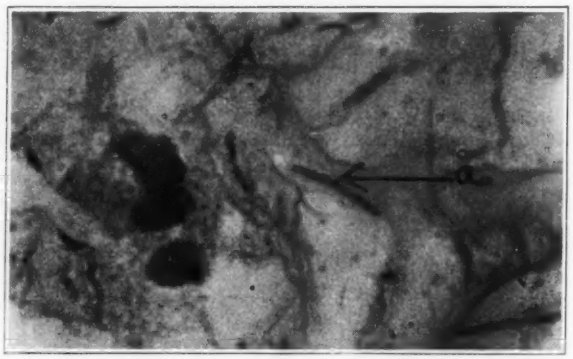


Fig. 16.—Spread of gingival exudate, Case F. The fusobacillus containing four regular intracellular granules at *a* was isolated from this specimen in pure culture.

The fusobacteria with irregular granules associated with clumps of large coccoid forms (Fig. 13) is from a fifth transplant of a culture made from a

chronic treated long-standing case (D, Table 2). The cocci and bacilli both persisted in further transplants in the gelatin medium and only the cocci grew on plates streaked with inoculum from the gelatin transplants.

Figure 14 illustrates the exudate in Case E, described in Tables 1 and 2, the pocket from which the exudate was obtained. Apparently, there existed pathogenic fusobacteria and cocci without the usual supposed symbiotic relationship of the spirochete. We were successful in obtaining a pure culture of the fusobacteria, which had granules, irregular both in number and in shape. Some of the

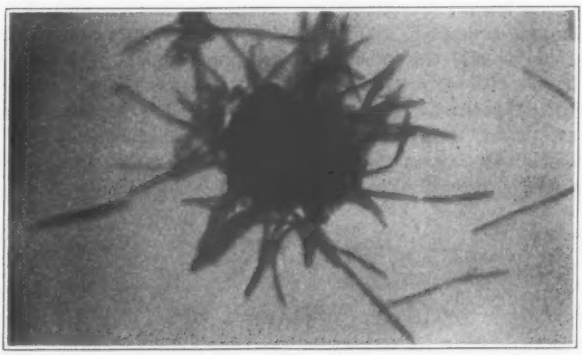


Fig. 17.—Spread from pure culture of fusobacillus shown at *a* in Figure 16. The similarity of cocklebur formation commonly found in exudate and that illustrated in Figure 4 is to be noted.

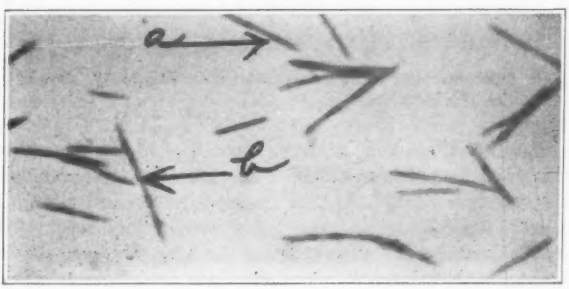


Fig. 18.—Another field of preparation shown in Figure 17. *a*, fusobacillus having two granules; *b*, one having four granules. (×1200.)

and Figure 15, the fusobacteria isolated from this specimen. This case is interesting because of the absence of the spirochetes and comma forms in the fresh material. There was a great abundance of pus cells and marked tissue reaction in granules appeared to be extending beyond the cell membrane (Fig. 15). Comparatively speaking, the bacilli in this culture were shorter and more slender than those in the fresh material. This species of bacillus produced no growth on plates.

Figures 17, 18 and 19 are photomicrographs of a culture made from the gingival exudate shown in Figure 16. The structure of this species of fusobacillus appears to be identical with that of the organism at *a* in Figure 16. Both have round pointed ends, are approximately the same size, and have round regular deeply staining granules, entirely within the cell membrane, evenly spaced and occurring in numbers of two and four. We have learned to identify this species of fusobacillus in the fresh material and find it occurs with the greatest frequency in chronic treated cases. It is commonly seen in cocklebur formation (Fig. 4). There is a tendency toward this formation in culture (Fig. 17). We believe that it was this species which we isolated from the blood stream in 1931.[13] At that time, we had no photomicrographic equipment and made a drawing of the spread from a brain broth culture tube.[14]

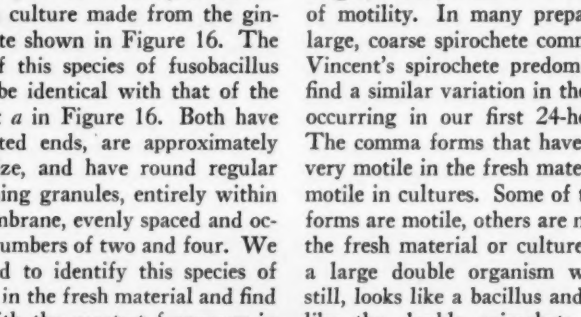


Fig. 19.—Single fusobacterium, from culture shown in Figure 17, showing round regular, evenly spaced granules. (×1800.)

MOTILITY

The motility of numerous preparations of the exudate and of cultures was studied under dark-field illumination. In the fresh material, the spirochetes vary in length, width, number of coils and type of motility. In many preparations, the large, coarse spirochete commonly called Vincent's spirochete predominated. We find a similar variation in the spirochetes occurring in our first 24-hour culture. The comma forms that have flagella are very motile in the fresh material and less motile in cultures. Some of the bacillary forms are motile, others are not, in either the fresh material or cultures. There is a large double organism which, when still, looks like a bacillus and, in motion, like the double spirochete, known as *Treponema bucalle*. Smith[15] is of the opinion that this bacillus, which he has called Type I, is identical with the spirochete, *T. bucalle*. Our observations tend to substantiate this opinion. We have obtained it frequently in our first cultures, but have not isolated it. All motile forms in cultures are less active than in the exudate, and their motility decreases on successive transplants. Neither strain of bacilli isolated in our cases E or F (Table 2) was motile.

COMMENT AND SUMMARY

In the present investigation, for every

13. Footnote 1, first reference.
14. Footnote 1, first reference, page 752, Fig. 12.
15. Smith, D. T.: Fusospirochetal Diseases, Baltimore: Williams and Wilkins Co., 1932, p. 17.

culture, the inoculum used was obtained from a natural area of anaerobiosis. The bacterial flora grown in the first 24-hour culture contained, in a marked similarity of predominance, the same five morphologic types of bacterial life, i.e., bacillary, coccoid, spiral, comma and filamentous, as did the inoculum. While other investigators have reported the isolation of fusiform bacilli and of spirochetes from various sources, including lesions in cases of Vincent's infection and lung abscesses and the surfaces of normal teeth of human beings and animals, to our knowledge none have correlated the cultural findings with the fresh material from which the culture was made. They do not report investigations of the corresponding inoculum. The question might be raised: Was the species of bacteria isolated present in the inoculum, or was it picked up as a contaminant? There are, no doubt, many spore-bearing organisms, widely disseminated in nature, which produce bacilli in a favorable environment. We have reported the life cycle of a higher bacterium[16] producing an anaerobic bacillus, the spores of which were found in dry agar and survived after the usual autoclaving of mediums for cultural purposes. As long ago as 1877, Cohn[17] first demonstrated the *B. subtilis* form spores, which were much more resistant to heat than the vegetative cells. Also, Koch,[18] in the same year, showed that the organism responsible for anthrax was the spore-forming *B. anthracis*. The fact that so many of our cultures on successive transplants resulted in the persistence of only the coccoid forms and that other investigators report a predominance of the granular phase in old cultures leads us to believe that cultural methods are not efficient in maintaining the vegetative cells. Slanetz and Rettger,[8] who have studied fifty-three strains of fusobacteria and typed them according to biochemical and cultural characteristics, state that numerous granules were present in old cultures of their Type II; that in the old cultures of their Type III, the cell outline faded away and granules developed, and that, in their Type IV, granules appeared in old cultures. We have in progress studies of the coccoid phases of our cultures anticipating a reversion to other forms.

The fact that we were not able to isolate fusobacteria with the apparent ease with which Slanetz and Rettger[8] isolated thirty-eight strains from the normal teeth of fifteen persons is probably due to a difference in strains. We know that fusobacteria were present in our inoculum, which was secured from a strictly anaerobic environment, down deep in the gingival tissues, and our strains of fusobacteria are, no doubt, strict anaerobes, while those obtained from surfaces of teeth probably are not. It would be interesting to know whether fusobacteria were present on the swabs[8] after they had been rubbed over the surfaces of the normal teeth just before the cultures were made from them, or if only cocci were present that produced bacilli when grown in optimum mediums under anaerobic conditions.

The two strains of fusobacteria that we have isolated from pus obtained from the depth of inflammatory gingival tissues have marked morphologic differences (Figs. 15 and 17) in both the cell body and in the intracellular granules. We have not attempted to identify these species with the types of Varney, Smith

16. Dean, R. D.; Dean, Marguerite T., and Gridley, Mary F.: J. D. Res., 11:877-884 (Dec.) 1931.

17. Cohn: Beitr. z. Biol. d. Pflanzer, 2:249-276, 1877.

18. Koch: Beitr. z. Biol. d. Pflanzer, 2:277-310, 1877.

or Slanetz and Rettger,[19] as there seems to be no uniformity in the morphologic characteristics ascribed by these workers to their respective types 1, 2, 3 and 4. We have in progress further studies of the biochemical, serologic and cultural characteristics of our strains. We believe that the fusobacterium which we isolated from the blood stream[13] had the same morphologic characteristics as the one isolated in the present investigation (Case F, Figs. 17, 18 and 19).

We have correlated the predominance of the different morphologic types of bacterial growth found in the fresh material with the clinical manifestations of Vincent's infection. Wagener[20] states that she considers their laboratory diagnosis of Vincent's infection positive only when *T. vincenti* (also classified as *Borrelia vincenti)* is found as the predominating organism and that it is in the tissues in acute Vincent's infection and in deep necrotic pockets that the predominating organism is *T. vincenti.* Our investigations tend to confirm her observations. We find that, in some cases of acute Vincent's infection, the comma forms predominate in the first few days of the attack, and it is later that the spirochetes increase in numbers. Our cases A and C, Table 2, illustrate these statements.

By acute cases, we mean those that so frequently occur in young adults and sometimes in children, the patient giving a history of the first attack and complaining of a sudden development of a soreness of the mouth, bleeding of the gums and foul breath. A more detailed description of the acute form has been given by many clinical writers.[21]

The bacillary and filamentous forms frequently predominate in the chronic cases, with very few spirochetes present, and sometimes totally absent in pockets, as was shown by our Case E, Tables 1 and 2. There is a definite inflammatory process involving much of the gingivae, and the clinician not having the aid of stained spreads may diagnose the condition as chronic Vincent's infection.

Often, a very foul odor and hemorrhage are present in cases wherein the large fusobacteria (Figs. 2, 3 and 5) are the predominating forms. The coccoid forms are equally associated with the other four forms. They are always present, even in very deep pockets.

The combination of a practical medium[8] and a convenient method of anaerobiosis[11] used in this investigation permitted the daily observation of cultures which showed that fusobacteria and spirochetes develop in twenty-four hours, while heretofore it has been believed that from forty-eight to seventy-two hours or even a longer period of incubation was necessary. We anticipate that this cultural method will result in more positive fusobacteria blood cultures in cases showing a marked local fusospirochetal infectious process in the oral cavity or lungs, or elsewhere in the body. We expect to carry out investigations along this line.

We believe that the dental practitioner could contribute much valuable data by routinely making stained smears and dark-field studies of gingival exudate and keeping a record of his findings, associated with the clinical signs and symptoms. Such a procedure would be of diagnostic value. The preparation of the specimens requires little time and could be done by his hygienist or assistant. The bacteriologic investigator who is inter-

19. Footnotes 4, 15 and 8.

20. Wagener, Edna H.: J. D. Res., 10:591 (Oct.) 1930.

21. Footnote 1, first reference. Merritt, A. H.: J. D. Res., 13:51 (Feb.) 1933. Rosenthal, S. L.: Dental Cosmos, 71:890 (Sept.) 1929.

ested in oral cultural studies should not limit his interest to fusobacteria and spirochetes, but should work with any bacterial species encountered regardless of morphologic structure. He should attempt to isolate any strain of bacteria possible, to establish its identity and to determine its pathogenicity and its bio-chemical and serologic characteristics.

RESTORATION OF LOST FACIAL DIMENSIONS AND CONTOUR FOR THE EDENTULOUS PATIENT*

By H. O. BROWN, D.D.S., Rochester, N. Y.

IN the construction of artificial dentures, we are faced with a multitude of problems. They come at us from every angle, and, indeed, it is a resourceful man who can prepare himself to cope with them. Our hope of success demands that we be prepared to meet and overcome at least a large majority of them. The mechanical ones can usually be met by experience and study, coupled with the strictest of attention to details. We can and should learn to construct cases that are mechanically correct. This is mostly a matter of technic. This part of the work has been so well developed by those who have gone before us that to fail in this regard is inexcusable. Volumes have been written on it by men who have spent years in perfecting their technic. These men have been most generous in placing this information before us, and we have no excusable reason for not applying it. Possibly, no one man has the ideal method, but by studying the work of each, and applying such parts as are best suited to us, we should each be able to formulate for ourselves a workable technic.

The psychologic problems are the ones that possibly demand the greatest resourcefulness, and, in meeting these problems, a knowledge of human nature is of great assistance to us. There are no set rules for handling these cases. Each one is different, involving the temperament of the patient and the difficulties that he has encountered before coming to us. Patients are often totally discouraged when first seen. This may be due to the fact that they have been trying to master a set of dentures that were faulty in their mechanical construction. It is never an easy job to correct errors of this kind, particularly when these patients come from a family other members of which have been having difficulty.

Again, there is the person who does not take into consideration the fact that mouths differ. We know that no two mouths are alike. To them, mouths are simply mouths. Often the patient for whom we are fitting a set of dentures is accompanied by a relative who has worn dentures for years. When the patient is complaining of looseness or soreness, the relative often hinders us by saying that he never had any trouble learning to wear his. This may have been true; on the other hand, he may simply have forgotten

*Read before the Section on Full Dentures at the Seventy-Second Annual Midwinter Clinic of the Chicago Dental Society, Feb. 20, 1936.

the troubles that he encountered at first.

Certain of our patients are fully reconciled to the fact that they can never wear a lower denture with any degree of comfort, simply because none have been worn in comfort by other members of the family. These people are apt to give up easily, and it is hard for us to persuade them that they can learn to wear their dentures. Artificial dentures are not like clothes, which can be buttoned on, or shoes, which can be tied on; the patient must learn to keep them in place. It is the first step in their new job. Mechanically, the upper is only a chopping block placed in the mouth for the lower to work against. It performs no work and should have no movement.

Another difficult psychologic problem is often presented when a young person is suddenly confronted with the necessity of having artificial dentures. Occasionally, the mere fact that he has lost his teeth makes him realize that age is creeping up on him. It is hard for us to make him see the situation in any other light. If he has a difficult mouth to fit, our problem is increased. The mere placing of artificial dentures in certain of these mouths completely breaks down the patients' morale. It is hard to persuade them that every one they meet is not criticizing their appearance. Often, these dentures can be placed so ingeniously that no one but the immediate family is conscious that they are artificial; but this does not erase the fact from their minds—they continue conscious of them long after they should have forgotten them.

In handling these psychologic problems, experience is a great help, as is true of mechanical ones. We must know who is right when these things confront us, and be perfectly open-minded in our decision. We should be as honest with the patient as with ourselves. If there is some mechanical difficulty, and there usually is when trouble continues to arise, we should be willing to recognize the fact and correct it. If it calls for remaking the case, we should not try to justify ourselves by saying that the patient could learn to wear them if he would, when an honest survey shows that we have overlooked some step in construction technic. It is often difficult to maintain a correct perspective when we are analyzing problems arising in our own cases. Do we not, too often, try to place all the blame on the patient? On the other hand, we may be trying to assume too much of the patient's responsibility. We should remember that while we make the dentures, we do not wear them. It is just as important that the patient do his part as that our work be correct. Our greatest problem in this work is to know who is right when trouble arises. This may be a psychologic question, or it may be a mechanical one.

The problem in which I am chiefly interested this morning is an anatomic one. We can foresee it, but as we cannot forestall it, we should prepare ourselves to meet it in the best possible manner. We are dealing with soft, yielding tissue. When the natural teeth were in place, the alveolar bone had a definite function to perform. Now that the teeth have been lost, it has no further function. When a part of the body ceases to function, nature proceeds to eliminate it. On this question, we are at odds with a force over which we have comparatively little control. We want to keep the alveolar bone in place, but natural forces are trying to throw it off. The preservation of this bone is one of our mechanical problems, but its replacement is an anatomic one. Man never has succeeded in a battle against nature. Therefore, we must reconcile ourselves to the fact that, in the end, nature will win. Along with the loss of this bony tissue comes the inevitable occlusal change,

bringing with it a loss of facial dimension and contour. To be forewarned should be to be forearmed, so we must prepare ourselves and our patients well ahead of time for this exasperating change. If we explain this at the start, we are not going to face the embarrassment of producing an alibi when the change occurs; nor will we be called on to remake cases for nothing after they have been worn a year or two. Artificial dentures never change form once they have been made. To the layman, they have the appearance of shrinking, if we do not compensate in the beginning for the folding up of muscular tissue that results when vertical dimension shortens.

In placing a set of dentures, we should bear in mind that we are not simply taking twenty-eight pieces of carved porcelain, putting them on saddles, which have been formed over casts of the mouth, and calling the result a set of artificial dentures.

This paper does not deal with the particular tooth form selected for an individual case; nor does it specify any color or mold other than to stress the fact that the tooth selected should be of a color and form which will harmonize with the case in hand. The tooth selected should be about the size of the natural tooth, and the amount of denture material that goes to make up the denture should be the exact amount and shape of the bony tissue lost.

If we succeed in making such a replacement, we need have no fears that the distorted muscular tissues will not early regain their original positions, and the face be restored to its normal contour.

There are three rules that must be kept in mind at all times:

1. A correct vertical dimension must be reestablished.
2. The distal corner of the cuspids must equal the desired width of the corners of the mouth.
3. The cuspid eminences must be built out with denture material until they equal in width the distal corners of the teeth below them.

In reestablishing the correct vertical dimension, we are: (1) restoring the shortened facial muscles to their original lengths; (2) removing unnatural strain on the adjacent muscles, and (3) allowing space in which these muscles can function. By building out the distal aspect of the cuspids properly, we are stretching the upper lip and removing the little perpendicular wrinkles. This also prevents a view of the posterior teeth, thus showing less porcelain. The building out of the cuspid eminences allows the orbicularis oris to fall into its correct position.

By lengthening the vertical dimension, we (1) eliminate the lines at the alae of the nose, (2) narrow the nostrils, and turn the corners of the mouth upward.

In this manner, we reshape the entire lip. In treating these points, let us bear in mind that we are speaking of the ideal case, the case in which we are attempting to replace with artificial substitute all of that material (bone and teeth) which has been lost through extraction and absorption. True, there are cases in which we must compromise. We cannot always work for the ideal owing to conditions over which we have no control.

If the patient is well along in years and is wearing a fairly successful set of dentures, even though it may be lacking in every detail from an esthetic standpoint, it is often wiser to let it alone, or, at best, simply add a few millimeters in width and height rather than try to work for the ideal replacement and run the risk of causing unnecessary discomfort. The older the person, the harder it is for him to adjust himself to change. Unless there is some pertinent reason for an ideal replacement, such as a temporomandibular impingement causing pain or deafness, it

is wiser to fall short esthetically than to burden them with a bulky replacement. Occasionally, these people come to us not so much because they need new dentures, as that some member of the family has urged them. Often in cases of this type, we would be rendering a better service if we simply rebased the denture. We might increase the thickness in the cuspid region or even remove the original cuspid and substitute a broader one, filling out the area above to conform to the new width.

Occasionally, we are confronted with cases which need extensive replacements owing to the fact that shortening of the vertical dimension has allowed the mandible to impinge on the anterior wall of the external auditory meatus, possibly causing deafness, pain or tinnitus. In these cases, we simply must increase this dimension if we are to achieve the desired results. If the patient is in a position to have several sets of dentures made, our work is much simpler, as, by increasing the opening gradually, we can be surer of obtaining the correct dimension. Sometimes, these patients cannot do this, and we have to establish the new dimension in the initial dentures. We have no way to estimate the amount of bony tissue that has been lost, except possibly by inserting our fingers in the ears and feeling for the mandible as it comes back upon closing. This is a very arbitrary method for an extensive replacement. No one can be certain the dimensions are correct. Remember that certain of our cases are adversely affected, by even 2 mm. of wear on the natural teeth. No one could be expected to know definitely that he is opening the correct amount when he attempts to replace from 9 to 15 mm. of additional space. Such a replacement naturally carries with it an enormous distortion of facial expression, which does not become an improvement until the dentures have been worn for several months. We must simply set an opening which we think is correct, build the case and wait for time to tell us whether we have established the proper dimensions. Remember that this work is an experiment as far as the amount of opening is concerned. We may have to change it. Large openings should be attempted only when the results are warranted. It would not seem that simply an improvement in facial expression would justify such a radical change. The patient and not we will be the final judge in this. A little experience will go a long way in correcting these, and we will soon find ourselves expert in judging the amount to be added. We should remember that it is the added vertical dimension coupled with proper cuspid to cuspid width which assures these results. We do not have to give any attention to putting these muscles where they belong. All we have to do is make room for them. If we replace all of the bony tissue that has been lost, we can be sure that our patients will regain their former facial expressions. But we must allow space into which these muscles can drape themselves, and not attempt to push them where we think they belong. Let us always remember that if faces are distorted, it is because of one of two things: the muscles have been pushed out of place by the encroachment of other muscles or they have folded up on themselves because of loss of the bony understructure.

The orbicularis oris, as well as the orbicularis oculi, are normally circular muscles held to their correct shapes by the attachment of other muscles. Without a correct vertical dimension, these other muscles lose their normal shape and function. This distortion is reflected in the appearance of the face. Once a vicious circle of distortion starts, be it from loss of teeth, malocclusion or wear, this dis-

tortion will manifest itself in the entire facial expression.

Eyes change in various ways. Some of them will be pushed shut and they then have the appearance of squinting. Others will be drawn open and thus have a haggard appearance. Others will seem to protrude, as if pressure was being applied from behind. Regardless of the nature of the distortion, these organs all seem to regain their correct shape when the causal condition is removed.

Noses, lips and chins are probably most affected from an esthetic standpoint. They are also the easiest to correct. It is hardly possible to add any vertical distance that will not improve them. The bulging of the masseter muscle and the loss of tension on the zygomatic major are probably the chief cause for the pouting of the cheek. This, in turn, tends to work havoc on the entire facial expression. Our object in correcting the understructure is to draw these muscles down tight against the bones of the face. By making them work in their proper positions, we restore their tone and eliminate the fat that has collected between their fibers.

Unless these muscles retain their correct lengths and shapes, their flabbiness is bound to be reflected in the general texture of the overlying skin. This causes it to become rough and uneven.

The youthful face is normally a perpendicular face, or, if anything, slightly convex. The nose is apt to be one of the outstanding features. As the vertical dimension is shortened, the chin gradually thrusts forward until it becomes the outstanding feature and the normally perpendicular, or convex face, gradually becomes concave.

BIOLOGIC PROBLEMS IN ORTHODONTIA*

By BALINT ORBAN, M.D., Vienna, Austria

A FEW years ago, from a study of the literature, one gained the impression that the biologic processes which take place in the jaw under orthodontic treatment are clearly understood. The most important experimental treatises in this field are the papers published by Sandstedt,[1] in 1904-1905, and by Oppenheim,[2] in 1911. For a long period, the paper by Oppenheim was regarded as the only one that was scientifically based. The paper by Sandstedt remained virtually unknown, for, though in German, it was presented in a Swedish journal, and after the death of the author, who

*From the Histologic Laboratory (Director, Bernhard Gottlieb) of the Dental Department (Director, Hans Pichler), University of Vienna.

*Translated from the original article, published in the Zeitschrift für Stomatologie, 33: 1037, 1935. An extensive bibliography accompanies the original.

1. Sandstedt, C.: Einige Beiträge zur Theorie der Zahnregulierung, Nord. Tand. Tidsschr., No. 4, 1904; No. 1, 1905.

2. Oppenheim, A: Die Veränderungen der Gewebe insbesondere des Knochens bei der Verschiebung der Zähne, Oester.-ungar. Vierteljahrsschr. f. Zahnheilk., No. 8, 1911, p. 302.

died young. It was A. M. Schwarz who recognized the importance of Sandstedt's paper. From our present-day knowledge, we may state that Sandstedt has experimented with particular ingenuity in periodontium and bone, and today we can confirm his findings and conclusions.

After the paper by Oppenheim, no experimental histologic article on tissue changes under orthodontic treatment was published for a long time. But in the last years, something has been accomplished, as indicated by the papers of Johnson, Appleton and Rittershofer,[3] A. M. Schwarz,[4] Rehak and Hattyasy,[5] Breitner[6] and Gubler[7] and the experiments of Gottlieb and Orban.[8] The problem of tissue changes in consequence of orthodontic measures, considered to be already solved, was again advanced for debate by these papers. There are especially to be referred to here the publications by A. M. Schwarz, who, on the basis of his experiments, was the first to give an available scale for measuring the force that we have to operate with in orthodontic procedures. He postulated that the force must not be stronger than the capillary blood pressure, i.e., about 20 gm. per square centimeter of pressure surface, but he could with much less

Fig. 1.—Section of tooth of dog. For two and one half weeks, the force was acting in the direction of the arrow. The strength of the force at the beginning of the treatment was 20 gm. *a*, marginal side of pressure. *b*, marginal side of pull. *c*, apical side of pressure. *d*, apical side of pull. *e*, tipping axis. (From Schwarz, International Journal of Orthodontia, April, 1932.)

3. Johnson, L. R.; Appleton, Jr., J. L., and Rittershofer, L. S.: Tissue Changes Involved in Tooth Movement, Internat. J. Orthodon., 12:889 (Oct.) 1926.

4. Schwarz, A. M.: Ueber die Bewegung belasteter Zähne, Ztschr. f. Stomatol. No. 1, 1928, p. 40; Mathematische Ueberprüfung des Verhaltens belasteter Zähne, ibid., No. 4, 1928, p. 398; Ein weiterer Beitrag zur Frage der Bewegung belasteter Zähne, ibid., No. 6, 1929, p. 499; Die Gewebsveränderungen bei orthodontischen Massnahmen, Fortschr. d. Orthodon., No. 3, 1931, p. 381, No. 4, 1931, p. 540; No. 1, 1932, p. 11, No. 2, 1932, p. 154; Tissue Changes Incidental to Orthodontic Tooth Movement, Internat. J. Orthodon., 18:331 (April) 1932; Ligatur oder Feder? Ztschr. f. Stomatol., No. 21, 1933, p. 1344, No. 22, 1933, p. 1417.

5. Rehák, R., and Hattyasy, D.: Ein interessanter Fall von beiderseitigen Hochstand der Eckzähne, Fortschr. d. Orthondon., No. 1, 1932, p. 76.

6. Breitner, C.: Experimentelle Veränderungen der mesiodistalen Beziehungen der oberen und unteren Zahnreihen, Ztschr. f. Stomatol., No. 1, Part 1, 1930, p. 134; No. 7, Part 2, 1930, p. 620; No. 4, Part 3, 1931, p. 343. Breitner, C., and Tischler, M.: Ueber die Beeinflussung der Zahnkeime durch orthodontische Bewegung der Milchzähne, Ztschr. f. Stomatol., No. 23, 1934, p. 1383.

7. Gubler, W.: Zur Frage der orthodontisch verursachten Wurzelresorptionen, Schweiz. Monat. f. Zahnheilk., No. 10, 1931, p. 1011.

8. Gottlieb, B., and Orbán, B.: Die Veränderungen der Gewebe bei übermässiger Beanspruchung der Zähne, Leipsic: Georg Thieme, 1931.

force, namely, with a continuous spring force of 3.5 gm., produce practically adequate tooth movement; i.e., 1 mm. within about four weeks. He then classified the force into four different degrees of efficacy, defining them as "weak," "medium" and "strong," according to their biologic effect, and thus gave to the practitioner an available scale for the absolute amount of the maximal force to be applied.

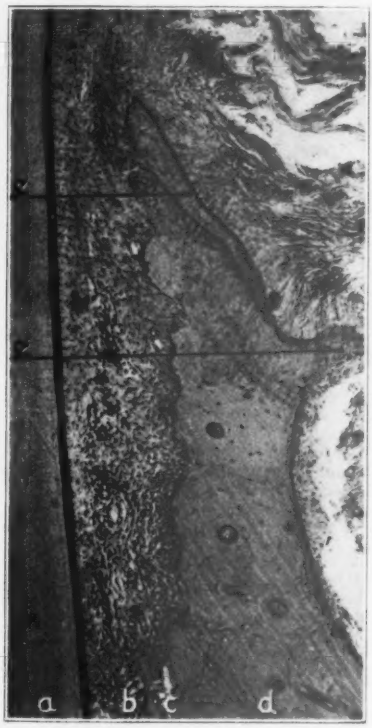


Fig. 2.—Higher magnification of area *a*, Figure 1; side of pressure; resorption on inner side of alveolar bone. *a*, tooth. *b*, periodontium. *c*, line of resorption. *d*, lamellated bone. *e*, fibrous bone on outer side of alveolar bone.

The book written by Gottlieb and me may be mentioned here.[8] By raising the bite of dogs by means of crowns, we were able to study experimentally all changes which may take place in the periodontal space under stress. As we examined each intermediate stage from an overload lasting twelve hours up to more than one year, we could systematically observe the development and the subsidence of all changes. Without these experiments as a basis, I should not dare to speak on biologic problems

Fig. 3.—Higher magnification of area *b*, Figure 1; apposition of bone on side of tension. *a*, lamellated bone. *b*, newly built bone with enclosed Sharpey's fibers, fibrous bone. *c*, periodontium. *d*, tooth.

in orthodontia; for every orthodontic moving of a tooth by means of appliances is an overstress in the biologic sense.

Oppenheim tried, in his paper "Crisis in Orthodontia,"[9] to support his stand of 1911 with new experiments, especially

9. Oppenheim, A.: Die Krise in der Orthodontie, Berlin: Urban & Schwarzenberg, 1933.

new argumentations on the previous findings, and there developed a lively discussion of the subject.

The questions broached did not seem to be answered. On the contrary, those who heard the papers read by Oppenheim the past year in Vienna and in Prague, and the subsequent discussions, unfortunately received the impression that the solution of this problem may still be far off.

In the lectures mentioned, Oppenheim reports on experiments that he carried out

Fig. 4.—Higher magnification of apex, Figure 1. *a*, apical side of pressure. *b*, apical side of tension. The sides of pressure and tension on the apex are situated diagonally from the corresponding marginal areas.

in men, in which he extracted the teeth moved, together with the surrounding bone, and then made a histologic examination.

In these lectures, Oppenheim also declared doubtful that which had seemed to be well based. Thus, for instance, he asserted that animal experimentation is not comparable to natural processes in man, as he thought to see in men other changes than in animals, both dog and monkey; and, furthermore, that the most sensitive, or, as Oppenheim expressed it, "the most vulnerable" tissue, of the periodontium is the cementum, which will be affected as soon as pressure is exerted. We have always thought the contrary to be true.

Particularly the lecture read by Oppenheim in Prague,[10] on which I had oc-

Fig. 5.—Section of tooth of dog, under stress in the direction of the arrow for forty-eight hours. *a*, area of pressure on alveolar margin. *b*, area of pressure on apex. Opposite the areas of pressure, there is widening of the periodontal space. These are the areas of tension. (From Gottlieb and Orban: Tissue Changes in Traumatic Occlusion.)

10. Oppenheim, A.: Die Krise in der Orthodontie, Ztschr. f. Stomatol., No. 7, 1933, p. 447; No. 8, 1933, p. 518; No. 11, 1933, p. 723; No. 14, 1933, p. 899; No. 15, 1933, p. 962; No. 22, 1933, p. 1394.

casion to speak in the course of the discussion, has made me decide to occupy myself with this question. This is justified by the experimental work, I, together with Gottlieb, have done on tissue changes in the teeth of the dog under great stress. We have not only restricted ourselves to an investigation of the

Fig. 6.—Higher magnification of area *a*, Figure 5. The periodontal membrane was compressed between tooth and bone until necrosis *(a)* ensued. Resorption cannot take place there, but is seen only in the neighboring marrow spaces *(b)*.

changes in the jaws of the dog, but, in studying human material, we have demonstrated all the changes found in our experimental material, stage by stage.

For years, I, together with Weinmann, have studied human jaws to see what changes appear in the case of excessive or irregular stress on teeth in the jaw. We determined that there is scarcely any jaw to be found that would not exhibit signs of an acute or chronic trauma on at least one or more, teeth. The teeth change their position as the result of trauma, and we have the orthodontic experiment of Nature before us.

Fig. 7.—Area *d*, Figure 5; apical side of pull. *a*, greatly widened periodontal space. *b*, formation of bone trabeculae, corresponding to tightened fibers of periodontium.

On the basis of these observations, I must oppose the assertion of Oppenheim that animals react otherwise than men. We find in the human jaws exactly the changes that we see in experiments in the dog.

I cannot let pass the assertion of Oppenheim that "the cementum is the most

vulnerable tissue of the periodontium." We see human teeth moving a tooth width, which resorbs the bone on the side of pressure without the least resorption taking place on the tooth surface. Oppenheim could not have successfully regulated teeth for more than a fourth of a century had the cementum been approximately as resorbable as he now presumes.

Fig. 8.—Section of tooth of dog. The tooth was moved with a force of about 60 gm. during two and one half weeks. There is a marginal area of pressure. The periodontium has been crushed between tooth and bone *(a)*. The blood vessels are thrombosed. An undermining resorption of the bone has begun from the adjacent areas that were not under pressure *(b)*. Where the resorption has widened the periodontal space, rebuilding of bone begins *(c)*, because the resorption has become sufficiently extensive. (From Schwarz, Zeitschrift für Stomatologie, 1932, p. 1041.)

Before taking up the discussion of findings, I should like to advance a few objections. We have been questioned on the ground that, while in our experiments on the dog, we used strong, intermittent force, we have recommended a gentle, continuous force as biologically adequate in orthodontia. The question seems to be justified, but I must maintain that continuous weak forces—weak in the sense of the second biologic degree of action according to A. M. Schwarz's scale—seem best in applying biologic principles.

It must be expressly stated here that as for bone, it is irrelevant whether an intermittent or a continuous pressure or traction is exerted. The bone, and especially the connective tissue covering the bone, have but two biologic functions: osteoclastic resorption and osteoblastic deposition. This fact, known long since, is apparently often overlooked in the biology of orthodontia. The bone has no other possibility of reacting to traction and pressure than by deposition and resorption. Whether the action of a force is continuous or intermittent or the force is gentle or strong is irrelevant. As long as the connective tissue is vital, it will accomplish its task in the same manner; and therefrom arises one of the most important postulates for orthodontic practice: The action of force may be only of such nature that it does not destroy the vitality of the periodontal connective tissue. Sandstedt has recognized this, and we may only enlarge on it. A. M. Schwarz has found 20 gm. per square centimeter of surface to be the maximum for this continuous pressure, the force therefore being equivalent to the average capillary blood pressure. Speaking of pressure, I must emphasize that, as long as it does not compress the periodontal connective tissue between tooth and bone

to the state of anemia, it is, in my opinion, perfectly irrelevant whether we apply a continuous or an intermittent force. It is also irrelevant whether we use an outer or an inner arch, and it is, furthermore, irrelevant whether the force is transmitted by ligature or by spring to the tooth and thereby to the connective tissue; the main point from the biologic aspect being that the force must not exceed the desired intensity.

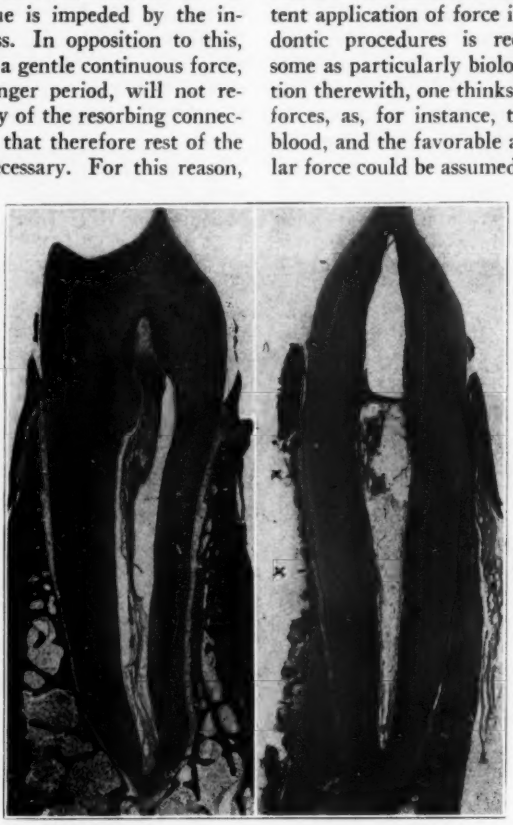
Of course, the question rises as to what changes become manifest in the periodontal tissue, if a strong force is exerted on a tooth for only a short time, as occurs, for instance, during mastication. Also, in this case, the connective tissue may be injured, but will soon be repaired if the injury is not repeated. It is presumable that such acute injuries will never attain the extent of those developing in consequence of longer, excessive force.

As to pressure, I must discuss another movement requiring intermittent force instead of continuous. As soon as the effect of pressure disappears, new formation of bone begins, consisting in deposition of uncalcified primary matrix in which later calcium salts are deposited. We know from histopathologic experience that osteoid tissue, i.e., uncalcified bone, cannot be resorbed so easily as calcified bone. Uncalcified bone is not, indeed, unresorbable, but we often see that uncalcified pieces of bone resist resorption longer than does calcified bone. Therefore, if the force moving the tooth is intermittent, periods of active movement succeed periods of rest. The bone newly formed during rest must always first be resorbed. The resorption of this

Fig. 9.—Section of tooth of dog; experimental traumatic occlusion, with period of stress of three weeks. *a*, completed undermining resorption of area of compression. Here, giant cells are taking the place of the remaining necrosed tissue. On the opposite side, there is active rebuilding of bone, due to tension. (From Gottlieb and Orban: Tissue Changes in Traumatic Occlusion.)

new bone will finally take place, but, according to our biologic conception, we must presume that the function of the connective tissue is impeded by the intermittent stress. In opposition to this, we believe that a gentle continuous force, also after a longer period, will not reduce the activity of the resorbing connective tissue, and that therefore rest of the tissue is not necessary. For this reason, from the biologic point of view, we prefer a continuous force to an intermittent one.

Because all life processes are intermittent and bone, in its growth processes, reacts to intermittent force, the intermittent application of force in case of orthodontic procedures is recommended by some as particularly biologic. In connection therewith, one thinks of intermittent forces, as, for instance, the pulsation of blood, and the favorable action of a similar force could be assumed. But, except in the force of mastication in a certain sense, or in orthodontia, there are no intermit-

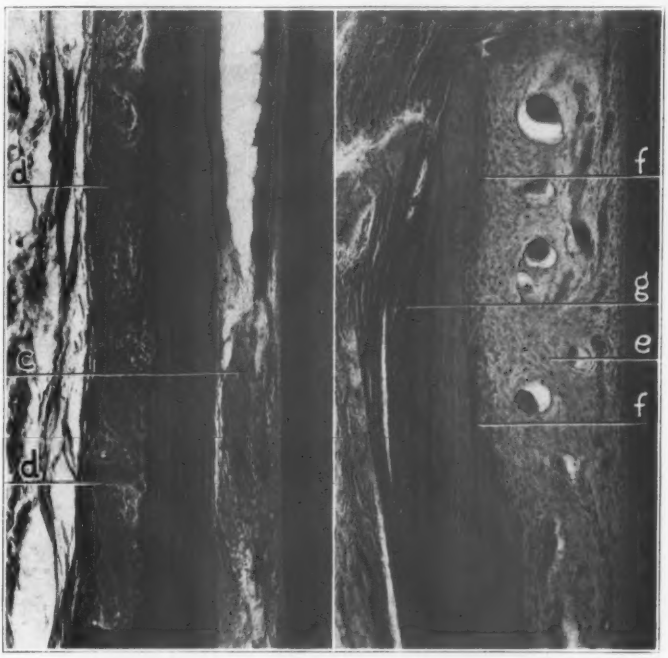


a b

Fig. 10.—Cross-section of two human teeth, both of which have been moved out of position because of faulty articulation. Left, bicuspid of person aged 19. The root is almost cylindrical. Right, incisor of person aged 19. The root is club shape. The tooth to the left has been moved through the cusps of the opposing tooth labially as well as lingually, and there is compression of the periodontal membrane on both sides at the alveolar margin. The cylindrical shape of the root accounts for the fact that the pressure is exactly at the alveolar margin. The tooth to the right has been stressed labially, a contusion in the periodontal space below the alveolar border, corresponding to nearly one third of the length of the root, resulting, because of the club-like shape of the root.

tent forces like the pulsation of blood. A force that is, although at ever so short intervals, renewed from time to time acts for a time continuously in comparison with pulsation, and if this force is too strong, it will certainly cause injury. If it were exactly administered, it would accomplish its task, and the further effect would depend on when the force was renewed. If it is renewed just when there is bone resorption, in ratio to the pressure, injury of connective tissue by compression results, and if it is renewed too late, the pressure meets young, new tissue, which surely will oppose greater resistance to resorption than will old bone. If we delay renewal of the force still longer, we may perhaps permanently establish the first mentioned process, as the new formed bone will, in the meantime, attain its normal degree of calcification; but we cannot speak, I think, of an intermittent force in this case.

In opposition to this, there is the continuously acting force of a gentle spring, which was activated, for instance, 1 mm. As long as the tooth has not moved 1 mm., the spring works continuously. Here



a b

Fig. 11.—Areas *x*, Figure 10, right. At the left, the area of highest pressure is shown. *c*, necrotic periodontal connective tissue. Outside the thin alveolar bone, there is building of osteophytic bone *(d)*. On the alveolar margin itself (right), the periodontium is somewhat widened. There is no necrosis. Also, on the outer surface, bone deposition is going on *(g)*. *e*, periodontal membrane. *f*, bone resorption.

too, the term "continuous" must not be understood in the strictest sense of the word, since mastication and other external influences prevent the force from acting without interruption. This circumstance is rather to be considered a disadvantage. The task of various technics would be to eliminate such influences as much as possible. On principle, the pres-

Fig. 12.—Undermining resorption of alveolar bone in region of apex of human molar in a person aged 24. *a*, dentin. *b*, cementum. *c*, necrotic tissue. *d*, alveolar bone, which becomes resorbed from the side *(e)*. *f*, granulation tissue. *g*, new bone trabeculae (osteophytes). (From Orban: Tissue Changes in Traumatic Occlusion, J.A.D.A., 1928, p. 2090.)

ent highly elastic appliances of the outer arch, with screw and spiral spring, etc., act in the same sense, if we proceed cautiously. These appliances increase the force much more than gentle springs do, particularly when the spring force, as A. M. Schwarz requires, is measured as to typical action, and therefore exerts a known amount of pressure.

It is not the task of biology to prescribe appliances, but is the duty of the practitioner to construct and to use appliances which are based on biologic principles.

An experiment made by A. M. Schwarz clearly demonstrates the typical tissue changes which appear about the teeth when orthodontic measures are properly applied.

Figure 1 shows a tooth that was

stressed by a loop spring with a force of 20 gm., corresponding to the cut on the crown, for two and one-half weeks. The result of this pressure is resorption of the inner alveolar wall on the alveolar margin of the pressure side. (Fig. 2.) On the opposite side of the tooth, the alveolar margin shows the effect of traction: Sharpey's fibers are immured in bone and there is progressive bone formation. (Fig. 3.)

On the apex of this tooth, there are also signs of pressure and traction. On the side where deposition is to be found on the alveolar margin, resorption sets in at the apex, and conversely. The changes about the apex are considerably less. (Fig. 4.) Therefore, the tooth was tilted from its position in ratio to the force exerted, and this around an axis at the apical third of the root.

This degree of change in bone in the course of an orthodontic movement presents the ideal; but, unfortunately, far too frequently this ideal cannot, for technical reasons, be attained. There are, indeed, much stronger forces applied, and more extended tissue changes result.

In experiments on dogs (conducted by Gottlieb and me), we could see similar tooth movements in the periodontium of molars of the left half of the jaw (the right molars were capped). In this case, the changes derive from the fact that the teeth also of the left half of the jaw are relatively overstressed in closing the jaws. We see, therefore, that similar tissue changes can be induced as much by continuous, gentle force as by a relatively intermittent one.

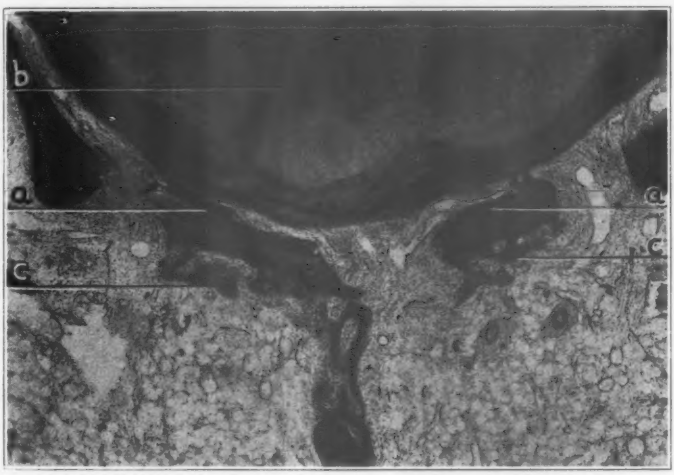


Fig. 13.—Apex of human molar of person aged 19. There is necrosis of the periodontal membrane *(a)* opposite the apex *(b)*, and building of osteophytic bone *(c)* beyond the areas of pressure.

Figure 5 represents a tooth of a dog (from Gottlieb's and my experiments) which was ligated to an arch placed labially of the tooth four times within forty-eight hours. As we can see, the tooth is tilted labially, and, on this side, it is pressed against the alveolar margin. Diagonally opposite this place,

we see the periodontal space also narrowed apically; whereas, labially, it is very much enlarged; just as enlarged as it is lingually on the alveolar margin.

Labially, the alveolar margin is seen in higher magnification in Figure 6. The periodontal connective tissue between tooth and bone is bruised and completely necrosed, and shows no tissue structure. In bone, there are no changes seen except

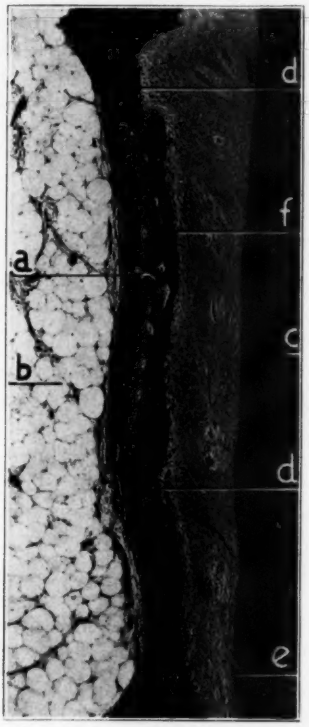


Fig. 14.—Building of bone *(a)* beginning from marrow space *(b)* beyond region of pressure in human molar of person aged 40. *c*, tooth. *d*, advancing resorption of alveolar bone. *e*, small resorption of tooth. The surface of the newly built bone *(f)* shows no resorption.

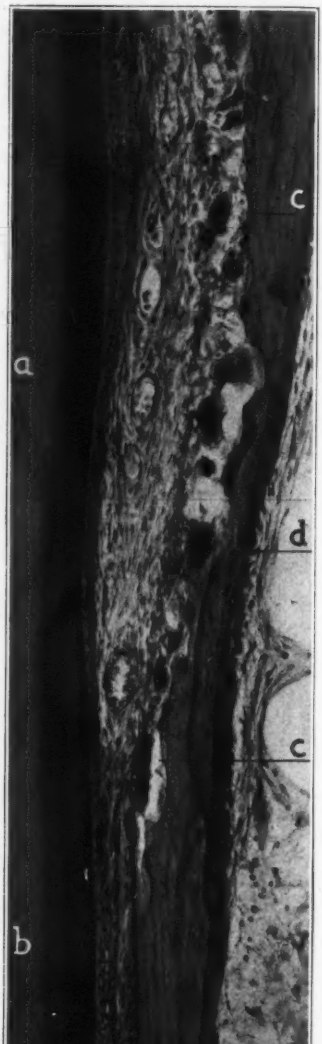


Fig. 15.—Section of dog tooth. (From Oppenheim, Zeitschrift für Stomatologie, 1933, p. 450.)

resorption in the marrow spaces which adjoin the bruised area.

If the periodontium had not been bruised, resorption of the inner wall of bone would have already set in, as we may observe in other cases, after twenty-four hours.

At the apical point of traction, we see considerable new formation of bone, corresponding to the supporting structures of the periodontium. (Fig. 7.)

How does the organism help itself if the periodontal connective tissue has been destroyed by the application of too strong a force? Beginning at the marrow spaces, as already has been seen in Figure 6, and also at the uninjured areas of the periodontal space, rapid resorption of the bone bordering the bruised area sets in. From this resorption, a gradual reduction of the bony impediment results. Such a case is seen in Figure 8, in which the tooth was exposed to a force of about 60 gm. Here,

Fig. 16.—Tooth of monkey. The tooth has been moved for forty days by ligation eight times to an arch. (Oppenheim.)

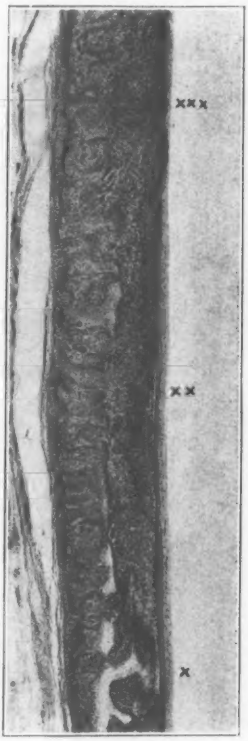


Fig. 17.—Higher magnification of area from Figure 16. *x*, area of contusion with complete necrosis of the soft tissue and progressive resorption. *xx* and *xxx*, marked cell activity, proving absence of areas of contusion. *xxx*, slight tooth resorption. *x*, most recent area of contusion, developing after *xx*, which was preceded by *xxx*.

the resorption of bone advances on both sides of the bruised area. If, then, all the bone which impedes the moving of the tooth is resorbed, the tooth can move. An entirely resorbed bruised area is to be seen in Figure 9, where only small pieces of necrotic tissue and residual osteoclasts indicate the area of contact.

If the acting force continues with approximately the same intensity, the bruised area develops anew and the process will be repeated till the force is exhausted. In orthodontic practice, as a rule, this sort of tooth movement will surely occur, especially where the applied force is not measured or is not measurable.

Fig. 18.—Higher magnification of area *x*, Figure 17. *a*, area of contusion, with complete necrosis of periodontal soft tissue and active resorption *(b)* of bone.

It is evident that there are dangers connected with this sort of movement. The greatest danger is that not only the bone, but also the teeth, can be more easily resorbed close to a bruised area on gentle pressure which does not injure the periodontium and especially the cementum surface, but only causes resorption of bone. If the periodontal connective tissue is injured, bruising of this tissue will not always result, but the vitality will be lessened by cutting off of the capillary blood supply. By a reduction of the tissue vitality, the tooth surface also can be injured. This may be the explanation of tooth resorption in orthodontic procedures. As to the individual capability of reacting, which surely is of some importance, we cannot say anything as yet. The resorbability of the cementum surface is certainly different in different individuals and may be more rapid in human beings than in dogs.

Another danger lies in the application of strong forces. Now and then, it is observed in orthodontic practice that the tooth movement has no tendency to advance, not even on application of a stronger force. I think that, in such cases, the application of a stronger force is the cause of this lack of movement, and the periodontium is bruised by the applied force. How rapidly the impediment is removed also depends much on the extent of the bruised area. If the injury is insignificant, as is seen in Figure 6, resorption may be expected, according to our experiments, within one or two weeks. But if the bruise is very extensive, eventually affecting half or two thirds of the whole root, resorption of bone and clearing away of necrotic tissue fragments can continue for months, and considerable time pass before the tissue has so much recovered that it can accomplish the desired

resorption. Above all, it is my purpose to warn against repeating such acts of violence, although "violence" may mean here a relatively gentle force of from 50 to 100 gm.

Whether by tilting movements a small or a large surface of the tooth is pressed against the bone depends—and the rule can be observed on application of either gentle force or a strong one—on the shape of the root. A. M. Schwarz has already pointed out that, in the case of a cylindrical root, the alveolar ridge is resorbed; but if the root is bulb-shaped, the alveolar ridge may be saved, and then the pressure extends below the alveolar ridge. In the case of bulb-shaped roots, the pressure field will also be more extensive; whereas, in cylindrical roots, the pressure field may be localized to the alveolar ridge. Of course, each root presents different contours in different directions on section, therefore pressure surfaces differ, according to site and size, in different directions.

In Figure 10, *a* is a bicuspid with an approximately cylindrical root, from a youth, aged 19; *b* is an incisor with a more bulb-shaped root, likewise from a youth, aged 19. The two teeth were moved from their position by the articulation, and show periodontal changes

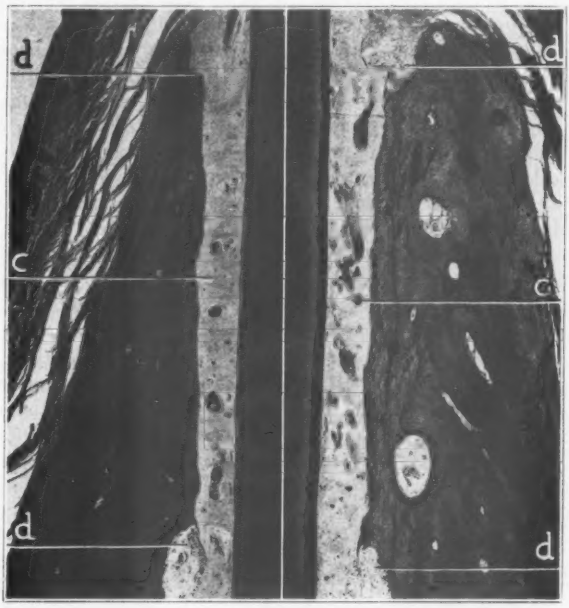


Fig. 19.—Higher magnification of both alveolar margins of tooth (left) from Figure 10. Bicuspid of person aged 19. Left, lingual bone margin. Right, labial bone margin. *c*, area of contusion of periodontal soft tissue on both sides. There is no staining of the cells. The blood vessels are thrombosed. There was jiggling of the tooth, which was moved by the cusps of the opposite tooth in both sides, labially as well as lingually. *d*, resorption beginning in the less compressed areas of the periodontal membrane.

completely resembling those observed in experimental overstress.

In *a*, there is a bruised area at the alveolar ridge, corresponding to the cylindrical root, and of relatively small extent. Findings on this tooth will be later referred to. In *b*, there is a pressure field below the alveolar ridge on the labial side extending a third of the root length. This pressure field extends along a small vault of the root, and, owing to this vault, the periodontium is not bruised about the alveolar ridge. The pressure maximum also in Figure 8 is to be found, in spite of the tilting movement, not at the alveolar ridge but below, at the bruised area. Had the force of 60 gm. exerted here taken effect on the alveolar ridge itself, the periodontium would have become necrotic there. But since it resorbed the bone at the alveolar ridge, apparently only a pressure of less than 20 gm. per square centimeter of surface has been exerted there. As now, as long as the bruised area is not resorbed, there is no pressure at all in the surrounding tissue, because the tooth movement is arrested, and we see the deposition of new bone beginning at the alveolar ridge.

In Figure 11, a part of the bruised area (*a*) and the alveolar ridge (*b*) of the teeth in Figure 10 is shown. We see at *a* that the periodontal space is completely necrotic (*c*), and without nucleus formation. Several thrombotic vessels are discernible. The inner wall of bone shows no resorption. This is not to be expected, as the connective tissue became necrotic. The alveolar bone is very thin at this point. At the bone surface, there is a new formation of bone in the shape of osteophytes (*d*), as we also frequently observed in our experiments in dogs, beyond the area of pressure. By this new formation, the bone is thickened and thereby disappearance of the whole alveolus from pressure is prevented. At the alveolar ridge, where, in consequence of the root shape, the periodontal space, especially the bone, was exposed to less pressure, we see (*b*, Fig. 11) the periodontal connective tissue in good condition and the periodontal space enlarged by resorption at the inner wall of bone (*f*). Here too, outside, there is new formation of bone (*g*), but more equal, lamellar and not of the distinctly osteophytic type. We see this sort of new formation of bone beyond pressure area more frequently in men than a bone thickening by formation of osteophytes, although such formations are not rare.

Thus, we see osteophytes very often beyond pressure areas near the apex. I have had occasion to present a few such pictures in a previous paper.[11] In Figure 12, a molar of a man, aged 24, is seen. The tooth was mesially tilted, because the neighboring tooth was missing. The apex moved distally, pressure areas and formation of osteophytes resulting (Fig. 12).

Another case is reproduced in Figure 13, in which a more axial trauma has caused bruising of the periodontal connective tissue and resorption of the alveolar bone. Here too, we see on the side of the marrow space of the trabeculae, which is under special pressure, new formation of bone of the osteophytic type.

In the paper by Richard Grohs,[12] we find a description of a similar case.

If the new formation of bone beyond a pressure area does not take place, disappearance of alveolar bone follows in this area. If the most intense pressure is directed against the alveolar ridge itself, shortening of the alveolar process may result, which would mean permanent dam-

11. Orban, Balint: Tissue changes in Traumatic Occlusion, J.A.D.A., 15:2090 (Nov.) 1928.

12. Grohs, R.: Veränderungen im Periodontium bei überlasteten menschlichen Zähnen, Ztschr. f. Stomatol., No. 4, 1931, p. 386.

age. If such a shortening of the alveolar process occurs in juveniles, in which case the risk of acceleration of epithelial proliferation is less than in adults, we can rely on repair of the damage after the pressure has ceased, as the alveolar ridge can lengthen again in ratio to the functional actions.

A new formation of bone beyond the pressure area is of importance not only at the alveolar ridge, but also at other points on the root surface. If a tooth is moved, the alveolar bone is resorbed. If the trabecula, being in a stage of resorption, was not strengthened by new bone on the side opposite the area of resorption, soon all marrow spaces on the side under pressure would communicate. Figure 14 represents a case wherein the alveolar bone was perforated by resorption in consequence of a traumatic tooth migration, and the bone marrow would have been in connection with the periodontium had not new bone formed, separating the marrow space from the periodontium and thus establishing a normal relation. We see on the side of the periodontium in the old bone rapid resorption; whereas, the new trabecula seems to resist resorption. On the side of the marrow space, bone is deposited by means of osteoblasts. The new trabecula presents a structure suggesting a precipitated deposition. Below in the picture, where the periodontal space is a little narrower, there is a little tooth resorption.

Figure 15 shows the conditions in the periodontium, which, from a biologic standpoint, were considered ideal for an orthodontic application. A lateral incisor of a youth, aged 19, is pressed laterally by its opposing tooth. Furthermore, we see rapid bone resorption along a considerable extent of the alveolar bone on the side of pressure. The periodontal connective tissue is not injured as regards its vitality. Also, the continuous deposition of uncalcified cementum that is so characteristic has set in. On the side of the marrow space, there is deposition of bone by osteoblasts. In the lower part of the picture, the periodontal space is very much narrowed. Bone resorption as well as cementum deposition has ceased here. The pressure in this part of the periodontal space has grown so intense that the connective tissue was apparently injured, though the pressure has not produced necrosis of the connective tissue.

If blood flows in again on decrease of pressure, the vitality of the periodontal connective tissue is restored. Then the connective issue is again able to accomplish its functions of deposition and, especially, of resorption of bone. This consideration would justify preference for an intermittent force in opposition to a continuous one. Nor is it denied that certain orthodontic appliances approach this aim. We have in mind appliances which allow rather free functioning of the teeth, as, for instance, biteplates of various types, the patients themselves regulating the force by biting on the plate and decreasing the biting power. In our examinations of human teeth, we frequently see that, in consequence of cusp interference, severe injuries, necrosis and bleeding may arise in the periodontium, which then must be eliminated by means of resorption. Therefore, it must be presumed that similar changes occur also on application of the popular and, in practice, successful biteplates, especially splints.

I must also express my opinion as to the much debated question of the tipping axis of a moved tooth. I shall do this from the biologic standpoint. From the physical one, it has already been done. A. M. Schwarz has demonstrated in detail that in matters of the application of forces all of which tip the tooth, regardless of whether a ligature or spring force

is applied, the axis may never lie at the root end. Schwarz showed that even in case of the most gentle force and a force directly at the alveolar ridge, the axis must physically be exactly in the apical root third, and only if the apical fiber apparatus is especially developed could it be displaced from this point a little in an apical direction. If the forces are stronger and the periodontium becomes anemic, the tooth will be pinched in the alveolus rather diagonally, its tilting axis being in the middle of the root. It may be stated now quite empiricaliy that in all my histologic examinations, I never saw the motion center at the apex. There were always marginal and apical zones of pressure, especially traction, demonstrable which extended diagonally. Of course, only central longitudinal sections are available for examination, as there the apex itself is to be seen.

As soon as there is a crushed area, a fulcrum for a farther acting force is presented. But if this crushed area is resorbed, the situation changes immediately. The tilting axis migrates in ratio to the actual given resistance of the alveolus. It is very instructive to study this experiment of Oppenheim, described in 1911.

In Figure 16, we see the picture of the tooth of a monkey. The tooth was ligated to an arch eight times in the course of forty days. The result of this action is an enlargement of the periodontal space lingually at the alveolar ridge, which is gradually narrowed toward the apical root third. Labially, the original alveolar bone is completely lost up to the point *x* at the root. This point is at the apical third of the root. The root is in reality longer than it appears in this figure, as the picture presents an oblique section. The bone from the alveolar ridge to *x* consists of new trabeculae, which are deposited in the form of osteophytes. From *x* to the root end, rather older bone trabeculae are to be seen. Therefore, in consequence of the pressure, all the old bone up to point *x* was resorbed and new deposited. In a higher magnification of the region about *x*, we see (Fig. 17) that a contact between the old alveolar bone and the tooth surface has come about. As a result, the periodontal connective tissue is crushed in this area and has grown necrotic. In the vicinity, rapid bone resorption is taking place, which would surely have caused complete resorption of the obstructing tissue if the animal experimented on had lived longer. There is new osteophytic formation of bone (Fig. 18) beyond this contact area. We can distinctly see where the old bone extends and how the external surface of the old bone passes into the internal surface of the osteophytic area toward the alveolar ridge. This is a sign that the old bone was gradually resorbed, beginning at the periodontium, the osteophytic bone apically advancing by degrees.

Furthermore, two areas in Figure 17 are especially worth considering. These two areas are indicated by *xx* and *xxx*. They are nothing but resorbed areas of previous contact, i.e., crushed areas. The darkly dyed portions are necrotic fragments of crushed connective tissue. Gottlieb and I have studied the behavior of these destroyed areas from their beginning to their complete disappearance, and thus I am able to interpret these findings in the manner just described. The tooth in question was ligated to the arch eight times. We may presume that in the first contact areas of all, there was complete resorption. The entirely new alveolar bone demonstrates this. The last bruise to develop is seen in Figure 17 at *x*, where the bone base is not yet fully resorbed, but resorption has already set in. At *xx*, we still see sporadic necrotic tissue as indicative of what has happened. At *xxx*, also a certain activity of the connective

tissue is to be observed, a sign that the tissue has been injured here.

It is perhaps comprehensible that Oppenheim had not perceived these particulars at that time. We have been in the same situation in interpreting the accidental findings in men and in experimental material. Only the classification of the experimental material according to the experimental periods offered the possibility of judging the sequence of the processes. We learned of the paper by Sandstedt from Schwarz, but later. Had it been known to us earlier, we could have spared ourselves many a difficulty as to the interpretation of our work. Although Oppenheim, when he wrote the paper on his first investigation, knew of Sandstedt's paper, he, at least for his own preparations, denied the presence of bruised areas and hyalinized connective tissue as described by Sandstedt, and in spite of the fact that these periodontal injuries are to be found in Oppenheim's own specimens as I have just demonstrated.

From the findings presented in Figures 16-18 it can be seen that the motion center of the moved tooth may change in the course of treatment. If the force is always renewed after a crushed area has healed, and it is not particularly intense, the contact area between tooth and bone will move apically in the course of time. Should we apply stronger forces, the tooth would be wedged at the alveolar ridge diagonally opposite the apex, as we have seen in our experiments in dogs in which the force was transmitted to the tooth by means of crowns cemented on.

Now, I should like to say something on so-called "jiggling," by which the orthodontist understands the moving to and fro of a tooth.

In our human material, we could often observe signs of such jiggling. In one case, the patient, aged 19, who had a complete set of teeth, died from tuberculous meningitis. The findings on the teeth indicated that the patient had surely had trismus. In consequence of the meningitic spasms, he gnashed his teeth, and thereby caused a jiggling of the teeth, which was arrested by the cusp tips of the opposite teeth. We see the result of this jiggling in Fig. 10*a*. On both sides at the alveolar ridge, there are the same bruised areas. By the movement lingually, a bruise has developed at the lingual alveolar ridge, and by the movement, labially, a bruise has developed at the labial alveolar ridge. The two crushed areas (Fig. 19) show that the periodontal connective tissue is chiefly necrotic, and the blood vessels are thrombosed. Along the entire bruised area, the bone is intact, since the necrotic connective tissue cannot resorb. On both sides of the bruised area, rapid resorption is taking place. It is by this resorption that the periodontal space was enlarged apically from the bruised area. If the patient had not died, and the grinding had continued, after a lapse of time the periodontal space would have enlarged both lingually and labially. From this enlargement of the periodontal space, a loosening of the tooth had resulted, because the retention of a tooth depends on the height of the alveolar ridge and the width of the periodontal space.

Hence, also in orthodontia, a movement of the tooth is desired only in one direction, and jiggling must be prevented, as it hinders the deposition of bone on the side of traction. In jiggling, there is no traction side, and it is just this traction on which the retention of a moved tooth depends. If bone is deposited regularly and in the desired extent on the side of traction during the moving of a tooth, the loosening of the tooth under orthodontic movement would scarcely have threatening aspects. But if the deposition is interfered with by pressure on the side

of traction, i.e., a tooth is jiggling to and fro, deposition of bone cannot take place. From this biologic point of view, the jiggling may be considered to be absolutely disadvantageous.

Two questions have been raised by orthodontists: the question of retention and of pulp injury in consequence of orthodontic procedures.

By moving the teeth, not only do we alter the structure of the bone near the teeth, but also the static conditions of all the jaw structure are changed by the new position of the teeth. The internal structure of the jaws follows the rules of static, and quite surely changes after tooth movement. Of course, we also know that the form of the jaw angles and joint, etc., changes in regulating the articulation. We think that retention is necessary as long as this internal transformation of the static jaw structure is not finished.

Also, here, the soft tissue of the jaws, i.e., the gums, is of importance. The soft parts are compressed and extended. This tissue too must adapt itself to the newly created conditions which perhaps develop more slowly than the bone transformation (Schwarz). To advance this adaptation, different measures were recommended. But I cannot discuss this in detail here.

Schwarz also pointed out that the blood vessels and the nerve fibers between the teeth supply the new bone less well than the areas of resorbed bone, and thus favor the restoration of the *status quo ante* for a time.

All these movements confirm the experience that the risk of relapse is less the slower regulation is made; i.e., the more time there was given to the jaw structure and the soft tissues for transformation and internal consolidation.

From the standpoint of biology, we must require that the retention appliances allow the teeth to function as freely as possible. Generally, this postulate is followed in modern orthodontia. The usual plate retentive appliances correspond to this prescription. The patients should be observed also during the retention period to adapt the appliances to the changes as the individual case requires. These changes still take place after regulation is finished in the sense of internal consolidation of the jaws.

We know that the periodontium and the alveolar bone of little functioning teeth, and, for instance, also in fixed bridges, show another structure than in normally functioning teeth. The periodontal space of teeth subjected to less than normal stress is narrower than that of normally stressed ones, the cementum thicker and structureless and the connective tissue loose and of less uniform structure. The network of the jaw spongiosa around teeth under less stress has wider meshes, and the single trabeculae are thinner than around normally stressed teeth. In constructing retention appliances, we must regard this fact. If we construct fixed retention appliances which do not allow the teeth to function freely, the adaptation of the structure and the whole jaw to the change will be possible, but after removal of the appliance. Therefore, we must also consider that the position of the teeth regulated, especially such retained teeth, will be altered. If we construct retention appliances that are as free as possible, we can count on a consolidation of the conditions during the retention period and shall experience less surprise after removal of the appliance.

The other question concerns pulp injuries. It is known to every practitioner that the pulp of entirely healthy teeth may die in consequence of trauma. Thus, there are reports on teeth the pulp of which has died in consequence of the trauma of regulation. On the other

hand, we know of severe trauma which did not cause pulp death. Cases of tooth fracture are related in the literature in which the fracture fragments were dislocated several millimeters without death of the pulp.

Therefore, individual anatomic conditions must be taken into consideration to explain why, in one case, the pulp dies and, in other cases, it does not. Unimportant bleeding in the pulp or signs of degeneration of the odontoblasts, such as are sometimes reported after orthodontic procedures, must not be regarded as serious, since we know that such conditions can be endured without especial consequences. The "shortening" or "lengthening" of a tooth may be especially dangerous for the pulp. In shortening, the circulation of the pulp could be cut off by pressing the root end; which is comprehensible only in quite definite anatomic conditions of the root-end area, where the vessel tract was wedged between tooth and bone. In lengthening, we could imagine that, in case of rapid procedure, vessels are lacerated, whereupon necrosis results.

By no means do occasional observations of pulp injuries justify general conclusions, as they are only of individual and local importance.

Another question which is very important for practical reasons must be answered here: whether teeth the apical foramen of which is not yet closed, i.e., in which the root growth is not yet finished, can be orthodontically moved. Oppenheim asserted, in his Vienna and Prague lectures, that teeth with an open apical foramen must not be regulated because there is a risk that the thin dentin of the root end may be fractured. He backed up this postulate by findings which he had made on the previously mentioned human teeth. He thought that he had observed fractures, but, after accurate examination, it was evident that these were artefacts and had not occurred in the mouth. From this evidence also, the practical deduction of Oppenheim was wrong.

How the still unfinished root-end reacts under stress was demonstrated by experiment (Johnson-Appleton-Rittershofer, Gottlieb-Orban). We could observe bending and deforming of the root ends without any other consequences. Also such deformations as are seen in the experiment in animals, are not to be feared in man during regulation, because, in orthodontia, considerably weaker forces are applied than, for instance, in the experiments of Gottlieb and Orban. If regulation is made with gentle force, a postulate advanced by us for other reasons, no deformation will arise at the root end. But even in cases in which the most intense force was applied, we have not seen any fractures, and therefore the possibility of a fracture may be disregarded. It is known that fractures with laceration in the cementum can be caused by trauma; but that hardly will occur in juveniles having an open apical foramen, even if ever so intense a force is applied. Of course, fracture with laceration is not excluded when pushing causes trauma or a sudden blow is given the tooth.

SUMMARY

1. The anatomic manifestations consequent on pressure and traction differ in no way in man and in the experimental animal. The statements of Oppenheim that the results of the experiments made by Gottlieb and Orban are not applicable in orthodontic procedure therefore are not justifiable.

2. The findings of Sandstedt published in 1904-1905 were fully confirmed by the investigations made by Gottlieb and Orban and A. M. Schwarz the last few years. Therefore, the conclusions of Op-

penheim (1911) do not agree with the facts, as he has overlooked the bruised areas described by Sandstedt and has interpreted the osteophytes demonstrated by Gottlieb and Orban as the result of transformation of bone trabeculae.

3. The root cementum is less sensitive to pressure than is bone. It is on this biologic quality of cementum that the possibility of an orthodontic tooth movement depends. Oppenheim paid no attention to the different reactions of cementum in his first publication (1911). Later (1933), he confirmed our statements on the special resistability of cementum in comparison with the alveolar bone. In his lectures in Vienna and Prague, he spoke of a "strikingly higher vulnerability of the cementum" in comparison with bone.

4. Root resorption occurs in tooth movement from the application of too intense force. Whether and to what extent it appears depends also on the individual, and in accordance with the age, the different sensibility of the root surface.

5. In a biologic sense, in orthodontia, there is only a continuous force, as no orthodontic appliance can exert a force which is similar to blood pulsation. The ligature likewise presents a continuous force, as it compresses the periodontium for many hours during several days. In a biologic sense, perhaps only the force of mastication (bite plate) operates as an intermittent force with the usual orthodontic appliances of today.

6. Bone can react only to traction and pressure with deposition and resorption.

7. The force by which a tooth is to be moved orthodontically must not be so intense as to interfere with the vitality of the periodontal connective tissue. It is evident without further comment that the vitality of the periodontal tissues is endangered by reducing the blood supply. Therefore, the postulate of A. M. Schwarz that, if possible, continuous force should be maintained under capillary blood pressure, gives to the practitioner a reliable means for judging the absolute intensity of forces which may be safely applied without causing damage.

8. The renewal of an orthodontic force at that moment when new bone has not yet been deposited on the bone surfaces resorbed by pressure results most favorably.

9. The essentially injurious force in which pressure is applied and released in rapid order and which we call "jiggling" results only in resorption; whereas, no opportunity is given for new formation of bone by traction.

10. A retention appliance should be worn until the internal transformation of the static jaw structure and the soft parts is completed. The appliance should be so constructed that it does not hinder the transformation of jaw structure.

11. Pulp injuries resulting from orthodontic procedure must be regarded as exceptional and probably are always associated with special anatomic conditions at the root apex.

12. The regulation may be accomplished without considering the degree of development of the apex and without risk of fracture.

INCIDENCE OF PULPAL INFECTION IN PERIODONTOCLASIA*

By CLARENCE P. CANBY, D.D.S., Washington, D. C.

A REVIEW of the dental literature indicates differences of opinion among investigators concerning the incidence of pulpal infection in periodontoclasia. This applies not only to teeth with varying degrees of periodontal involvement, but also to normal vital teeth with and without caries.

Careful work in oral bacteriology should have produced greater uniformity in results than have been reported. Complete agreement is not to be expected in all instances, because of the large number of factors involved. Aside from variations in the interpretation of roentgenographic evidence, in the physical condition of the patient and in methods of cultivation of specimens under examination, the factor of contamination, both at the time of securing the specimen and during the bacteriologic procedure, has been undoubtedly the greatest source of error in the results reported.

This problem of contamination is emphasized in a recent article by Hatton and others.[1] With the wide divergence of opinion existing relative to the sterility or nonsterility of the pulpal tissues, the general practitioner of dentistry is left in a maze of confusion. When patients suffering from systemic disturbances or remote suspected foci are referred to him by physicians, what his recommendations are to be becomes a problem. To be sure, the general practitioner does not desire to assume the responsibility for the retention of certain teeth that may serve as foci of infection, and thus be a menace to the patient's general health. The question arises as to how the general practitioner is to arrive at a correct evaluation of the oral conditions. This question is still unsolved, more exacting bacteriologic and histologic research being required for a definite solution. Eventually, sufficient statistical and reliable information will be at our disposal to enable dental consultants rather than physicians to make definite recommendations concerning the retention or nonretention of certain teeth.

RECORDED INCIDENCE OF INFECTION IN TEETH WITH VITAL PULPS

Normal Teeth Without Caries or Gingival Inflammation.—Rhoades and Dick,[2] in a bacteriologic study of fourteen normal roentgen-ray negative teeth, found thirteen of the teeth positive (93 per cent), with an average bacterial count of 1,876. Kelsey,[3] in an examination of fifty sound teeth with normal pulps,

*From the Dental Bacteriological Department, Army Dental School, Medical Department, Professional Service Schools, Army Medical Center.

1. Hatton, E. H., et al.: Comparison of Roentgen-Ray, Transillumination and Bacteriologic Examination of Pulpless and Infected Teeth, J.A.D.A., 23:191 (Feb.) 1936.

2. Rhoades, P. S., and Dick, G. F.: Roentgenographically Negative Pulpless Teeth as Foci of Infection: Results of Quantitative Cultures, J.A.D.A., 19:1884 (Nov.) 1932.

3. Kelsey, C. J.: Brit. D. J., 41:857 (Sept. 15) 1920.

found bacteria present in forty-seven (94 per cent). McDonagh[4] found that 65 per cent of thirty-four normal teeth examined contained micro-organisms. Haden,[5] in an examination of 400 vital noncarious teeth, reports 14.5 per cent of cultures positive in deep agar tubes and 55 per cent positive in broth. He emphasizes that the high percentage of positive cultures in broth as compared to that in agar represents a technical error due to contamination. Austin and Cook[6] found only four positive cultures (4 per cent) in an examination of 100 normal teeth. Heath,[7] in a study of twenty-one healthy teeth extracted from children in which periodontitis could be definitely excluded, found two positive cultures (9.5 per cent). The lack of sterility in these two cases, he attributes to contamination. Dutton and Cameron,[8] in their investigation of 108 normal vital teeth, report only 2.7 per cent positive after eliminating probable contaminants. Henrici and Hartzell[9] had no positive cultures in a study of twenty-two normal vital teeth.

Teeth With Carious Dentin (Gingival Tissues Normal or Showing Only Slight Gingival Irritation).—Kelsey[3] reports the presence of bacteria in 94 per cent of fifty-one teeth examined. The majority of the pulps were normal histologically, a few showing evidence clinically of pulpitis. Deacon and Schwartz[10] report positive 78 per cent of teeth showing advanced caries, 8.7 per cent of those with only slight caries. Dutton and Cameron[8] found that, in incipient caries alone, bacteria were present in 43.7 per cent of the teeth; while, in incipient caries with gingival recession, 64.4 per cent were infected. Henry, Sniffen and Doyle[11] obtained positive cultures from twenty-seven of fifty-eight teeth examined (47 per cent). Henrici and Hartzell[9] report ten positive findings (43 per cent) in an examination of twenty-three normal carious teeth. Cramer and Reith,[12] in a study of thirty-four vital teeth, the majority apparently showing caries, found only 15 per cent to contain micro-organisms. Goadby and Barrett[13] studied the bacteriology of acute pulpitis (without gangrene) in twenty carious freshly extracted teeth. In ten of these, a hard layer of unsoftened dentin existed between the cavity and the pulp chamber. No bacteria were present on culture, nor were any organisms seen in direct stained smears from the emulsified pulp tissue. Of the other group of ten teeth in which the dentin over the pulp showed actual softening, bacteria were present in seven of the teeth.

Teeth with Periodontal Involvement.—Hasegawa (quoted from Appleton[14])

4. McDonagh, A. J.: J. D. Res., 7:411 (Dec.) 1927.

5. Haden, R. L.: Dental Infection and Systemic Diseases, Philadelphia: Lea & Febiger, 1928, p. 41.

6. Austin, L. T., and Cook, T. J.: Bacteriologic Study of Normal Vital Teeth, J.A.D.A., 16:894 (May) 1929.

7. Heath, J. R. S.: Brit. D. J., 42:239 (March 5) 1921.

8. Dutton, E. M., and Cameron, G. C.: Canad. Pub. Health J., 23:436 (Sept.) 1932.

9. Henrici, A. T., and Hartzell, T. D.: J. D. Res,. 1:419 (Dec.) 1919.

10. Deacon, W. E., and Schwartz, B. F.: D. Cosmos, 77:1163 (Dec.) 1935.

11. Henry, G. W.; Sniffen, D. A., and Doyle, Mary C. H.: D. Cosmos, 72:1132 (Nov.) 1930.

12. Cramer, H. C., and Reith, A. F.: Quantitative Bacteriologic Study of Pulpless Teeth Correlated with Dental Roentgenograms, J.A.D.A., 19:976 (June) 1932.

13. Goadby, K. W., and Barrett, J.: Seventeenth Internat. Cong. Med., London, Sect. Stomatol., 1913, pp. 17, 31.

14. Appleton, J. T. L., Jr.: Bacterial Infection, Ed. 2, Philadelphia: Lea & Febiger, 1933, p. 461.

found bacteria present in the vital pulps of eight pyorrheic teeth examined (100 per cent). Henry, Sniffen and Doyle[11] cultured twenty-five teeth in cases of periodontoclasia and obtained growths in eighteen (72 per cent). Kelsey[8] obtained growths from nine (90 per cent) of ten noncarious teeth with periodontoclasia. Nichols[15] found 41 per cent of nineteen vital noncarious teeth with only slight pyorrheal involvement to be infected. Heath[16] demonstrated, from stained histologic sections of the pulp, the presence of bacteria in nineteen of twenty-three pyorrheic teeth. Henrici and Hartzell[9] obtained 42 per cent positive cultures in pyorrhea alone, including very mild gingivitis; while, when both caries and pyorrhea were present, positive cultures were secured in 46 per cent of the teeth.

Fig. 1.—Moderate degree of periodontoclasia.

Fig. 2.—Advanced periodontoclasia.

From a close study of the statistical data on the incidence of bacterial infection in vital pulps, it can be seen that results are not consistent. With the majority of investigators believing that normal vital teeth without caries or periclasia are sterile, such high positive findings as reported by Rhoades and Dick and Kelsey lead to confusion. The technic employed by Rhoades and Dick could readily account for their positive findings. They attempted to extract the teeth aseptically, and then, without further treatment of the external root surface, snipped off the apex into a small amount of broth, from which their bacteriologic studies were made. From my own experience in the laboratory, this method is unreliable. Similar conclusions have been reached by Bernier,[17] Deacon, Schwartz, Heath, Rickert, Cramer, Reith, Dutton, Cameron and others. The technic employed by Kelsey was more satisfactory, making it difficult to explain his high incidence of infection. A careful consideration of the organisms isolated from each individual tooth leads one to believe that contamination was present. He reports an extremely high percentage of mixed infections in which two or more organisms were present, together with a high incidence of gram-positive streptobacilli, staphylococci and gram-negative bacilli; which is not in accord with accepted bacteriologic findings.

Since such variations of opinion occur as to whether there are bacteria in normal teeth, it is difficult to arrive at any definite conclusion concerning the possible incidence of infection in teeth with vital pulps affected with varying degrees of caries or periclasia, as here again experimental findings are not in complete agreement.

The investigation reported here is a

15. Nichols, Anna C.: J. D. Res. (abstr.), 9:276 (June) 1929.

16. Heath, J. R. S.: Brit. D. J., 45:558 (May) 1924.

17. Bernier, J. L.: J. D. Res., to be published.

preliminary study on the incidence of pulpal infection in apparently vital pyorrheic teeth, secured from patients at Walter Reed General Hospital, Washington, D. C. In most instances, the specimens were from mouths in which the extraction of all remaining teeth was indicated because of generalized periodontoclasia. Thus, many teeth were necessarily discarded owing to alveolar resorption extending to or beyond the apical region. The teeth selected for bacteriologic examination were those remaining

Fig. 3.—Severe periodontoclasia.

Fig. 4.—Lateral incisor showing severe periodontoclasia.

ones in which the alveolar bone surrounding the apices of the teeth appeared roentgenographically negative, regardless of the amount of bone destruction. As a result, most of the teeth used in this study showed an advanced or severe type of periclasia. No particular aseptic technic was instituted in our extractions other than the routine daily technic that is employed in the oral surgery clinic of this hospital.

METHOD OF BACTERIOLOGIC EXAMINATION

The teeth, when removed, were numbered in their order of extraction and placed directly in separate sterile test tubes, with the crown portion downward in order to prevent the accumulation of the bloody exudate around the apical region. The teeth were sent immediately to the dental bacteriologic laboratory for culturing. With the exception of six teeth, which were placed in the icebox overnight, the bacteriologic examination was started immediately.

Technic.—To prevent any antiseptic from entering the apical foramina, and thereby exerting some bactericidal action through osmotic activity, the apices of 145 of the teeth cultured were covered with

Fig. 5.—Lateral incisor showing advanced periodontoclasia with extensive carious lesion.

sterile paraffin. Before the paraffin was applied, an attempt was made to free the apex of each root of possible contaminating organisms by touching the root end to fused Melotte's metal, or by burning with a fine pinpoint flame. Of the remaining nineteen teeth cultured, no attempt was made to close the apical foramina. The teeth were then placed separately in sterile petri dishes and flooded with 7.5 per cent iodine solution. All débris and adherent tissue was removed from the root surfaces with a sharp scalpel. After the iodine had remained for from three to five minutes, the teeth were removed and all traces of

iodine were washed off with 95 per cent alcohol. As soon as the alcohol had evaporated, the teeth were again placed in separate sterile petri dishes, and a control culture was made from each tooth by rubbing a sterile moistened swab vigorously over the root surfaces. The teeth were then snipped into two parts with large sterile bone forceps near the junction of the coronal and root portion. With a sterile barbed broach, the pulpal tissue was removed and placed directly in the culture mediums or in a tube containing 1.5 c.c. of gelatin-Locke solution, with a small amount of sand, for use as the inoculum when it was desired to make a Gram stain, and serial plate and broth cultures, both aerobically and anaerobically. The material placed in gelatin-Locke solution was thoroughly macerated against the sides of the tubes and then the remaining portion of the pulp tissue was extricated from the barbed broach by the aid of a sterile pulp-canal file. Finally, before inoculating the various mediums desired, these tubes were agitated for a short time to insure an even distribution of the material.

Mediums Employed.—Before selecting the culture medium to be used routinely in this experiment, several mediums were inoculated with aerobic and anaerobic streptococci isolated from infected root canals and serial cultures incubated under aerobic and anaerobic conditions. These included Robertson's (anaerobic) medium, veal infusion broth, brain-heart infusion and double strength veal infusion-brain broth containing 0.2 per cent glucose and a small piece of marble. (This medium is only a slight modification of the glucose-brain broth recommended by Rickert,[18] Rosenow[19] and Haden,[20] who have all stressed the importance of using a culture medium that provides for anaerobic or semi-anaerobic conditions, when dealing with suspected foci about the teeth.) After a series of experimental tests, it was concluded that use of the veal-infusion-brain broth mentioned above, adjusted to p_H 7.4, gave the most consistent results. Furthermore, employment of this medium did not require the incubation of culture material in an anaerobic jar. Numerous times throughout this present experiment, tubes of veal infusion-brain broth were inoculated and checked for growth, both aerobically and anaerobically, with the same results. One must keep in mind the fact that, many times, when growth appears in this medium, to isolate the organism or organisms in pure cultures, suitable plates must be inoculated and incubated under anaerobiosis. No attempt was made at any time to make quantitative determinations. On many occasions (thirty-six in all), blood-agar or serum-agar plates were inoculated with a loopful of material from the gelatin-Locke solution and incubated both aerobically and anaerobically. This was done with the idea in mind that if the pulpal tissues serve as sources of potential foci in periclasia, one should at least obtain a few colonies in a certain percentage of the cases. Negative results were obtained from these plate cultures in every instance. To check the efficacy of this method, in view of the negative results obtained above, control cultures were made from gangrenous pulps, or from teeth with definite exposure of the pulpal tissues to the fluids of the oral cavity. In the latter cases, a high percentage of positive cultures were obtained on the agar plates.

18. Rickert, U. G.: Report of Research Committee Financed by Michigan State Dental Society, J.A.D.A., 9:300 (April) 1922.

19. Rosenow, E. C.: J. D. Res., 1:205 (Sept.) 1919.

20. Haden, R. L.: Arch. Int. Med., 32:828 (Dec.) 1923

BACTERIOLOGIC FINDINGS

A total of 164 teeth showing varying degrees of periclasia were examined. All these teeth were apparently vital, with pulps appearing normal macroscopically. The apical alveolar bone gave no evidence of infection roentgenographically, although, in many instances, the teeth showing advanced or severe periclasia also showed an actual thickening of the peridental space.

To evaluate more exactly the bacteriologic findings, the teeth examined were classified roentgenographically into three groups on the basis of the periodontal involvement: Group I, moderate periclasia, those teeth in which one-third or less of the supporting structures were involved (Fig. 1); Group II, advanced periclasia, those teeth with one-third to one-half of the supporting structures involved (Fig. 2), and Group III, severe periclasia, those teeth in which more than one-half of the supporting structures were involved (Fig. 3, and Fig. 4, lateral incisor).

The accompanying table shows the number of teeth cultured, together with the findings for each group. The teeth recorded as carious were those with actual decay involving the dentin. All filled teeth and teeth with abrasion were classed as noncarious.

DATA ON TEETH CULTURED

Group	No. of Teeth Cultured		No. of Teeth Positive	Per Cent Positive	Total No. of Positive Teeth	Total Per Cent Positive
I	15	No caries 7	1	14.3	2	13.3
		Caries 8	1	12.5		
II	55	No caries 38	8	21.0	12	21.8
		Caries 17	4	23.5		
III	94	No caries 78	25	32.0	32	34.0
		Caries 16	7	43.7		
Total	164				46	28.0

In Group I, fifteen teeth were cultured, seven of which were noncarious and eight carious, with one positive culture in each division. In Group II, there were fifty-five teeth examined, thirty-eight of which were noncarious and seventeen carious, with the finding of eight positive cultures in the former, and four positive in the latter. Group III contained ninety-four teeth, seventy-eight of which were noncarious, with twenty-

five positive cultures, and sixteen carious, with seven positive findings. For the three groups, representing 164 teeth, there were forty-six positive cultures; a total percentage of 28.

Organisms Isolated.—Streptococcus viridans occurred in forty instances, twenty-six times in pure culture and fourteen times in mixed culture. In the mixed cultures, *Streptococcus viridans* was in association with *Neisseria catarrhalis* once, and in association with a gram-negative anaerobic coccus thirteen times. The latter organism is apparently the same bacterium as that described by Hall and Howitt[21] as the *Micrococcus gazogenes,* although my biochemical findings are not in complete agreement with their report. Hadley and Rickert[22] have also described this same organism as being present in root-canal infections. *Staphylococcus albus* occurred three times in pure culture. The three remaining positive teeth gave pure cultures of gram-positive rods, one being aerobic and two anaerobic. The identity of these gram-positive rods was not definitely established. From morphologic cultural and biochemical studies, the anaerobic rods were apparently members of the genus Bacteroides, while the gram-positive aerobic rods closely resembled certain members of the genus Cornyebacterium (diphtheroid).

Of the forty strains of *Streptococcus viridans* isolated, three of the strains (two from the same patient) gave, on first isolation, alpha prime hemolysis on blood-agar. After one or two transfers, this hemolytic property was lost, there resulting on blood-agar the typical greenish discoloration characteristic of the viridans group. An attempt was made to classify all of these isolated oral strains of streptococci in separate species by studying the morphologic and growth characteristics in broth and colonial appearance on serum-agar, together with the fermentation reactions. No consistency in the results could be obtained when the strains were tested and retested. As a result, the streptococcal organisms isolated are recorded here as representing a single species, *Streptococcus viridans.* Topley and Wilson,[23] in their discussion of the *Streptococcus viridans* group of bacteria, state, in substance, that there is little to be gained by naming varieties according to their fermentation reactions, owing to the variability of the permanency of the fermentative characters of any one strain.

One tooth (Fig. 5, lateral incisor) omitted from the table as unsuitable for culture because of the severity of the carious lesion, was cultured as a matter of related interest. The same sterilizing technic as for those teeth being investigated was used. The coronal and root portions of the pulpal tissues were placed separately in veal infusion-brain broth. Each portion gave a pure growth of *Lactobacillus acidophilus* (B. acidophilus). Examination of the carious area revealed no direct exposure to the oral fluids, although softened dentin extended beyond the pulp chamber.

COMMENT

The teeth recorded in the table were, with few exceptions, obtained from hospitalized patients having a generalized periodontoclasia. The findings refer to the incidences in which growth was obtained in broth cultures. This type of

21. Hall, I. C., and Howitt, Beatrice: J. Infect. Dis., 37:112 (Aug.) 1925.

22. Hadley, F. P., and Rickert, U. G.: D. Cosmos, 69:665 (July) 1927.

23. Topley, W. W. C., and Wilson, G. S.: Principles of Bacteriology and Immunity, New York: William Wood & Company, 1931, p. 357-367.

medium will give a higher percentage of positive results than if a quantitative method is used. Even though a qualitative method was employed throughout the experiment, only 28 per cent of the teeth gave positive growths. These findings are apparently not in accord with those of the majority of investigators relative to the incidence of pulpal infection in pyorrheic teeth. This difference becomes even greater when one considers that the majority of teeth cultured (Group III) were beyond operative treatment. Although in Group III there was a much higher percentage of positive findings in carious than in noncarious teeth, my observations in culturing carious teeth leads me to believe that, as long as a hard layer of unsoftened dentin exists between the decayed area and the pulp chamber, the possibility that pathogenic organisms will gain entrance to the pulp by way of the dentinal tubules is remote. (The reasons for this statement will appear in another article dealing with dental caries.)

The sterilizing technic employed was efficacious in freeing the root surfaces of contaminating organisms, as only seven positive controls were obtained. *Staphylococcus albus, Staphylococcus citreus* and oidium-like organisms occurred once each, while in the remaining controls, gram-positive spore-forming aerobic rods were present. All of these organisms indicated evident air contamination and had no bearing on the findings. In spite of this freedom of surface bacteria, organisms from the periodontal lesions apparently gain entrance to the apical pulp tissues at the time of extraction, contamination of the cultures resulting. This contamination has been stressed by other workers as probably due to the creation of a negative pressure during the extraction movements, drawing the organisms from an infected gingival crevice or pocket to the apical area. Deacon and Schwartz[10] further contend that the apical portion of the pulp may become infected by being partially drawn into the tooth socket and then returning through the foramen into the tooth after connections have been broken. When one considers the elasticity of the pulpal tissues, the deduction of Deacon and Schwartz is logical. With pyorrheic lesions harboring countless numbers of micro-organisms, it is likely that, in a certain percentage of cases, extrinsic organisms do gain entrance into the apical foramen by some mechanical means during extraction.

In this investigation, there were about an equal number of anterior and posterior teeth examined. The coronal and root portions of the pulpal tissues were cultured together in the majority of cases. Not until after 100 or more teeth had been cultured was any attempt made to check the probability of contamination in the apical portion of the pulp. After this, whenever possible, the coronal and root portions were cultured separately. Unfortunately, the method used in cutting the teeth did not always separate the pulp into its component parts. When the pulp tissue was distinctly separated, it was soon noted that the massive bulbous coronal portions gave a much higher percentage of negative cultures than did the corresponding root portions of the same teeth. In the last nineteen teeth examined, the apices of the teeth were not burned nor dipped into Melotte's metal, because these procedures may actually force contaminating organisms farther into the pulp tissues. The application of paraffin over the root ends was also discontinued in order to allow the penetration of iodine into the apical foramina. In these few instances, the results indicated that fewer positive cultures would have been obtained had the

latter technic been followed throughout the experiment.

The finding of *Micrococcus gazogenes*, a common resident of pyorrheic lesions, in thirteen instances, in teeth from Group II and III, indicates that this organism was probably nothing more than a contaminant. (When the nature of this organism, an anaerobic gas producer, is considered, it is doubtful that a tooth could harbor this organism without showing symptoms of pulpitis.) Such being the case, it is believed that a certain percentage of the streptococci, and probably the staphylococci and unidentified rods isolated, represented root-end contamination. This deduction appears logical, because, as previously stated, thirty-six platings from gelatin-Locke solution on blood-agar or serum-agar, incubated both aerobically and anaerobically, were negative. Furthermore, Gram's stains were made from the serous exudate or macerated portions of the pulp of twenty-five teeth, and from thirty of the gelatin-Locke inoculums, with no demonstrable organisms in any instance. To check up on the occasional reported presence of spirochetal organisms, six vital pyorrheic teeth (not teeth recorded in this experiment) were examined immediately after extraction by the dark-field method. The results were negative. These experiments indicate that roentgen-ray-negative vital pyorrheic teeth do not contain countless numbers of micro-organisms. If the factor of contamination could be eliminated, or the cultures could be obtained only from the upper portions of the pulp, it is probable that the incidence of infection would be extremely low, even in teeth showing marked resorption.

The entire technical and bacteriologic procedure of the foregoing investigation has been carried out by me in person, and not entrusted to laboratory assistants. The results of my observations on the 164 teeth described, together with many previous examinations of pyorrheic teeth, have led me to the conclusion that the frequent finding, by many investigators, of gram-positive streptobacilli, gram-negative bacilli, gram-negative aerobic cocci, hemolytic streptococci and staphylococci, aerobic spore-forming bacilli, as well as several distinct genera of bacteria, within one tooth, represent gross contamination at the time of extraction, or during the bacteriologic procedure, or both.

SUMMARY

1. A bacteriologic examination was made of 164 roentgen-ray-negative vital pyorrheic teeth.

2. The number of positive cultures for the entire group was 28 per cent.

3. Those teeth showing both caries and periodontoclasia gave positive cultures in 29.2 per cent of cases.

4. When the teeth were classified with respect to the amount of involvement of supporting structures, the percentage of positive cultures increased with the severity of the periodontal lesions.

5. All except fifteen teeth showed an advanced or severe type of periodontoclasia. They were secured, in most instances, from hospitalized patients, in which the extraction of all remaining teeth was indicated.

6. *Streptococcus viridans* was isolated in forty instances (24.3 per cent of the cases), twenty-six times in pure cultures and fourteen times in mixed cultures.

7. *Micrococcus gazogenes* was present in thirteen teeth, always in association with *Streptococcus viridans*.

8. The finding of numerous varieties or genera of bacteria in vital pyorrheic teeth probably represents contamination.

CONCLUSIONS

1. The pulpal tissues of vital roentgen-ray-negative teeth, showing only

slight or moderate degrees of periodontoclasia, are probably free of micro-organisms.

2. If these particular teeth are amenable to operative treatment, and the gingival pocket can be eliminated, that they constitute focal areas of infection is questionable.

A SIMPLE METHOD OF IMPROVING AMALGAM RESTORATIONS*

By FRANCIS A. BULL, D.D.S., Milwaukee, Wis.

FAILURES of amalgam restorations in the mouth can be attributed to (1) the weakness of the amalgam, which permits of transverse and shearing fractures, as evidenced in the mouth by fracture of the amalgam at the neck of the dovetail and by the shearing off of the cavosurface angle, and (2) the progressive distortion that takes place when amalgam is subjected to higher than room temperature. As an end-result of this reaction of amalgam to heat, from the body processes and from ingestion of hot food and drink, the amalgam filling gradually leaves the cavity wall in a progressive spheroiding action. This action not only destroys the seal necessary to prevent marginal leaks, but also causes the margin of the filling to chip and fracture under masticating forces, as there is no tooth support tight against the margins.

The slight increase from room temperature to mouth temperature has practically no effect on the behavior of most filling materials commonly used, but it does affect amalgam. The 25 to 30 degree increase in the mouth over room temperature has a marked effect on the behavior of amalgam. There is evidence of this in actual practice and it can be easily demonstrated in laboratory tests. Nowhere in the literature have I seen any reports on flow tests of amalgam at mouth temperature. Invariably, they are conducted at room temperature, the dentist assuming that a flow of less than 4 per cent at room temperature would be the same at mouth temperature. This is not true. Bureau of Standards regulation flow tests conducted by me, at both room and mouth temperature, show some startling differences. For example, an amalgam that flows 4 per cent at room temperature will flow 20 per cent at 98 degrees, or mouth temperature.

Undoubtedly, mercury is the element in restorations that permits the distortion that we encounter, and the rapidity and amount of distortion are governed chiefly by the amount of mercury in the mass.

How to increase the strength and eliminate the distortion of amalgam is the problem before us. It seems that construction engineers have furnished us the groundwork for improving amalgam restorations by their work in reinforcing concrete. Steel has been found the best reinforcing element for concrete, and experiments carried out with amalgam show that silver makes the best reinforcing ele-

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-Eighth Annual Session of the American Dental Association, San Francisco, Calif., July 14, 1936.

ment for amalgam, a chemical bond or union being obtained between the amalgam and silver reinforcing element that is much stronger than the mechanical or fractional bond between steel and concrete. In reinforcing concrete, only sufficient steel is used to give the necessary strength. In reinforcing amalgam, the silver reinforcing element can be of such dimensions as to displace a considerable amount of the mass, and thereby decrease the amount of amalgam in the finished product. Naturally, as less amalgam is used, less mercury will be present in the mass, the distortion factor being thus eliminated. When the silver reinforcing element has become chemically welded in the mass, it forces the amalgam to remain in position or to hug the cavity wall.

Tests showed that when amalgam was packed in a mold 2 by 2 by 15 mm. and allowed to set, it could easily be broken by finger pressure and, on a machine, it broke when only 3 pounds transverse force was applied. Dental cement of the same dimensions broke at 2 pounds transverse pressure. Tests were conducted to determine what improvement could be made by reinforcing the amalgam. With the 2 by 2 by 15 mm. molds, a strip or bar of sterling silver a little less than 1 mm. sq. was cut to loosely fit the mold. The mold was then packed with amalgam until it was about two-thirds filled, and the reinforcing strip of silver was placed on the amalgam and tapped with a mallet until it was approximately in the center of the mold. Amalgam was then packed over it, completely filling the mold. Several of these amalgam casts were made. When removed from the mold, after setting, they were tested by finger pressure, but they could not be broken in that way. When placed on the testing machine, they gave way at 18 pounds transverse pressure, showing a 500 per cent increase in strength over plain amalgam. For comparison, a gold casting was made from the same mold and tested for transverse strength, giving way at 21 pounds pressure. Cement, 2 pounds; amalgam, 3 pounds; reinforced amalgam, 18 pounds, and cast gold, 21 pounds, transverse strength gives us a picture that we can translate in terms of failure or success of dental restorations.

To determine how much difference there would be in the crushing strength of plain amalgam and reinforced amalgam, several tests were conducted. Cylinders about 4 by 8 mm. were used, and circular pieces of sterling silver less than 1 mm. thick were cut for the reinforcing element. Several cylinders were packed, some with reinforced amalgam and some with amalgam alone. After setting for a week, they were given the compression or crushing test. The plain amalgam cylinders were broken at 350 pounds pressure and the reinforced amalgam cylinders at 600 pounds pressure.

Cylinders 4 by 8 mm., of both plain and reinforced amalgam, were again prepared that the flow test might be made. These tests were made over a seven-day period instead of the usual twenty-four-hour period. In all cases, the amount of flow of the reinforced amalgam was less than one half that of the plain amalgam.

There is no questioning the fact that greatly increased strength can be supplied to amalgam by reinforcing it as described; and, likewise, that sandwiching the rigid silver plates or bars into the amalgam must overcome the internal stress of the amalgam, which causes the distortion or spheroiding action in amalgam restorations at mouth temperature. It remains for some simple technic to be worked out, based on evidence presented here and on established principles of reinforcing similar materials, such as con-

crete, that the general practitioner of dentistry may include this procedure in his service to his patients. As no costly material is used, the time element alone is the factor to be considered.

A brief outline of the procedure and technic that have proved to be practical in my hands is as follows. Plates of sterling silver from 0.025 to 0.035 inch thick are obtained. These plates are then cut in long strips of various widths, 1 mm., 2 mm., 3 mm., etc., up to one half inch. Having the reinforcing material cut in these strips makes for easier handling of the material when grinding or cutting it to simulate the outline of the cavity. In the case of single surface cavities, after the proper cavity preparation, a strip of sterling silver is selected that is considerably narrower than the cavity. From the end of this strip, a small plate is fashioned having an outline corresponding to that of the cavity. Amalgam is now prepared and the cavity is packed with it until about two-thirds filled. The reinforcing plate is laid on the amalgam and gently tapped with a mallet until the plate is in the center of the cavity. Then, amalgam is packed over the plate, and the filling is completed. In single surface cavities where there is no strength factor and the reinforcing plate is used simply to prevent distortion of the amalgam, it is not necessary to have the reinforcing plate in one continuous piece.

Cavities involving two or more surfaces of a tooth necessitate a different procedure. The portion of the cavity below the plane of the pulpal wall is treated as one unit and the remainder of the cavity as another. Plates coextensive with but smaller than the gingival seat are used to build the filling up to the plane of the pulpal wall. A plate coextensive with and smaller than the occlusal outline of the cavity is used to reinforce the occlusal portion of the filling, except the area adjacent to the cavosurface angle. Here, we must reinforce fillings against shearing force, and that can be accomplished only by having the reinforcing plate tight against the cavity wall and just below the surface. To accomplish this with the occlusal plate is a complicated procedure, but a much simpler method of gaining the same result was found. When the occlusal plate is cut, no attempt is made to follow the cavity outline in the proximal portion. A v-shaped piece of the reinforcing material is cut which can be placed tightly against the cavity wall at the cavosurface angle and just below the surface. This splice or overlap principle of reinforcing simplifies both the cutting and the placement of the plates.

When the cavity (mesioclusal) is prepared, the above-mentioned plates are cut and the matrix band is adjusted. Amalgam is well packed over the gingival seat, the gingival seat plate is placed on the amalgam and tapped against the seat and amalgam is packed over the plate. More plates may be added until the plane of the pulpal wall is reached. Then amalgam is packed over the entire occlusal aspect, until it is about two-thirds filled. The occlusal plate is placed on the amalgam and tapped until it is about the center of the cavity and amalgam is now packed over the plate filling the cavity. Then, the v-shaped plates are placed in the regions of the cavosurface angle and tapped tightly against the cavity wall and just beneath the surface. These are then covered with amalgam and, after setting, the restoration is finished in the usual manner. Should some part of the reinforcing plate appear on the surface when restoration is finished, no harm is done, except that the plate will discolor more rapidly than the amalgam. In a mesioclusodistal restoration, the occlusal plate

follows the occlusal outline and extends into the mesial and distal portions of the cavity.

The dovetail retention does not need to be any larger for a reinforced amalgam restoration than for cast-gold, as they will have approximately the same strength. Extension of compound cavities to the buccal and lingual aspect can be carried out without fear of failure. Likewise, to the extent we make use of the reinforcing plates, we cut down the amount of expansion and contraction in the completed restoration.

COMPARATIVE MERITS OF VASOCONSTRICTORS IN LOCAL ANESTHETIC SOLUTIONS: THEIR PRACTICAL APPLICATION*

By HOWARD C. MILLER, D.D.S., F.A.C.D., and
CARROLL W. STUART, D.D.S., M.D., F.A.C.D., Chicago, Ill.

THE occasional occurrence of unpleasant or even alarming reactions following the injection of a local anesthetic solution forcibly impresses one with the fact that the problem in this field is not as yet entirely solved. Since 1884, when Koller first described the local anesthetic effect of cocaine, the history of this humane procedure has been marked by an effort to elimate all objectionable side effects. In 1901, advantage was taken of the vasoconstricting properties of epinephrine to delay absorption of the anesthetic agent, thereby prolonging anesthesia and diminishing the toxicity of the cocaine. In spite of this development, untoward symptoms continued to be of such frequency that a compound having the local anesthetic properties of cocaine was sought. In 1905, Einhorn succeeded in synthesizing procaine (novocaine). Here was a drug having the anesthetic properties of cocaine, but with about one-seventh its toxicity. Unfortunately, procaine had a serious drawback in that it had no constricting effect on the blood vessels. It became necessary, therefore, to add a vasoconstrictor to make procaine as effective a local anesthetic as cocaine. The addition of epinephrine accomplished that purpose, but the solution still failed to achieve the ideal, as is indicated by the many reports of unfavorable reactions to be found in medical and dental literature. It is a known fact that the toxic symptoms of both cocaine and epinephrine are potentiated when these drugs are injected in combination. No doubt, similar undesirable effects are obtained when procaine is substituted for cocaine, although certain authorities assert that this is true only when the solution is deposited directly in the blood stream.

In a paper presented before this society in 1934, one of us (H.C.M.) made the following statement:

A vasoconstrictor in some form is necessary in the use of a local anesthetic, and, in the majority of solutions now used, is present in the form of epinephrin in varying amounts. This agent is necessary to

*Read before the Section on Surgery, Radiology and Anesthesia at the Seventy-Second Annual Midwinter Clinic of the Chicago Dental Society, Feb. 18, 1936.

constrict the blood vessels and retard the absorption of the anesthetic, thus localizing the action of the latter and prolonging anesthesia.

It is a well-known fact that the disturbing features of local anesthesia, such as alarming and unpleasant reactions, occur most frequently in susceptible patients through the use of solutions containing epinephrin. Therefore, it is necessary to be certain of the amount of epinephrin contained in every solution. The epinephrin content must be regulated in accordance with the physical condition and the age of the patient, the extent of the area to be injected, and the manner and rapidity of injection.[1]

Epinephrine, in combination with cocaine or procaine, has been the subject of intensive study during its wide clinical application, particularly with reference to the symptoms produced. These symptoms may be classified as either subjective or objective. The subjective symptoms are: apprehension; a sensation of unsteadiness or tremor in the abdomen, accompanied by a general weakness; heart consciousness, marked by palpitation and a sensation as if the heart were turning over or rising in the throat; fulness, or throbbing, in the head, and a sense of constriction, pressure or pain in the chest. The objective symptoms are: an anxious expression; labored respiration, usually accompanied by a rapid pulse; pallor, which quickly spreads over the face; tremor; beads of perspiration on the forehead; and, occasionally, signs of emotional instability bordering on hysteria. If these symptoms are ignored, syncope may occur.

PERCENTAGES SHOWING INITIAL BLOOD PRESSURE REACTIONS TO THREE ANESTHETIC SOLUTIONS*

Solution	Total No. of Cases	No Change in Pulse Pressure		Changes in Pulse Pressure				
		Systolic Rise Diastolic Rise	Systolic Fall Diastolic Fall	Systolic Rise Diastolic Fall	Systolic Fall Diastolic Rise	Systolic Rise Diastolic No Change	Systolic No Change Diastolic Rise	Systolic No Change Diastolic Fall
		Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
Epinephrine, 1 to 20,000, procaine 2 per cent	67	25.37	15	31	15	7	1.4	4.5
Epinephrine 1 to 50,000, procaine 2 per cent	70	21	17	15.7	38.5	1.4	2.8	1.4
Cobefrin 1 to 10,000, procaine 2 per cent	163	48.4	14	18	15	0.1	.18	.1

*Figures compiled from data recorded during first four minutes after injection was started.

1. Miller, H. C.: Local Anesthesia, J.A. D.A., 21:1937 (Nov.) 1934.

The toxic manifestations of procaine must be differentiated from those of epinephrine. Although procaine is from one-fifth to one-seventh as toxic as cocaine, and is the safest of all local anesthetics, certain patients possess an idiosyncrasy to it. The symptoms of procaine intoxication differ from those resulting from epinephrine administration, in that they occur more slowly, are more persistent and do not recede nearly so rapidly. They are characterized by resemblance to surgical shock. General depression and a more or less marked fall in blood pressure are outstanding symptoms. The patient is usually quiet, seldom restless. He may complain of being cold, owing to the rapid lowering of body temperature; or of being dizzy. The respiration is shallow and irregular; the skin, cold and clammy; the eyes, dull and expressionless, with the pupils dilated. Nausea and vomiting may occur. The patient may be conscious, although bordering on a state of semiconsciousness. In cases of extreme intoxication, he may become totally unconscious and pass into coma, with cessation of respiration followed by death.

The injection of a solution of procaine without the addition of any form of vasoconstrictor is occasionally requested by a physician. Such an injection presents a far greater hazard than if a solution containing one of the weaker vasoconstrictors were used, because the rapid absorption of the procaine markedly increases the danger of toxic reactions. It also results in a transient anesthesia, which increases the danger of pain due to insufficient anesthesia.

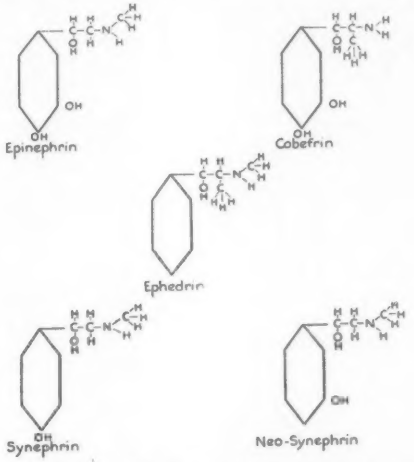


Fig. 1.—Chemical formulas of five vasoconstrictors.

Other agents have been studied in the effort to find one having the same vasoconstricting effect as epinephrine in combination with procaine, but without its unpleasant after-effects. Among the compounds that have been given clinical trial are ephedrine, synephrine, neosynephrine hydrochloride and cobefrin hydrochloride. All of these are more or less closely related chemically to epinephrine. Paralleling this chemical simi-

larity is a like pharmacologic action.

Ephedrine has the vasoconstricting action of epinephrine, but in combination with procaine is not so efficient for local anesthetic purposes. Ephedrine is less likely to produce the objectionable reactions induced by epinephrine. While this compound has found a wide field of usefulness in medical practice when constriction of the arterioles is desired, it appears to have little value in conjunction with procaine and related anesthetics for vasoconstrictive purposes.

Synephrine, which was introduced as

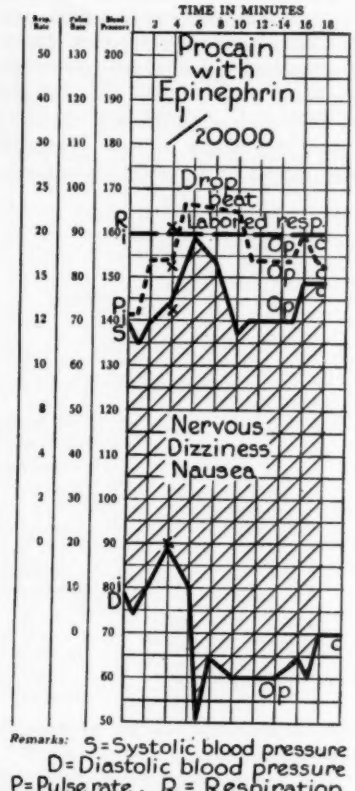


Fig. 2.—Graph showing typical reactions when procaine 2 per cent with epinephrine 1:20,000 was used.

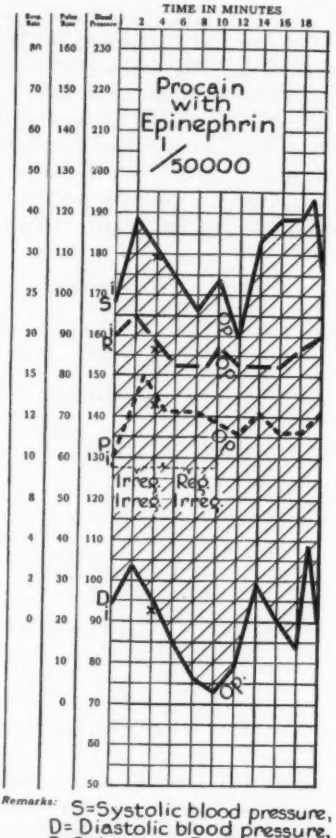


Fig. 3.—Graph showing typical reactions when procaine 2 per cent with epinephrine 1:50,000 was used.

another substitute compound, is a much less effective vasoconstricting agent than epinephrine, but has one definite advantage in its extreme stability. This unfortunately does not offset its weaker vasoconstricting action.

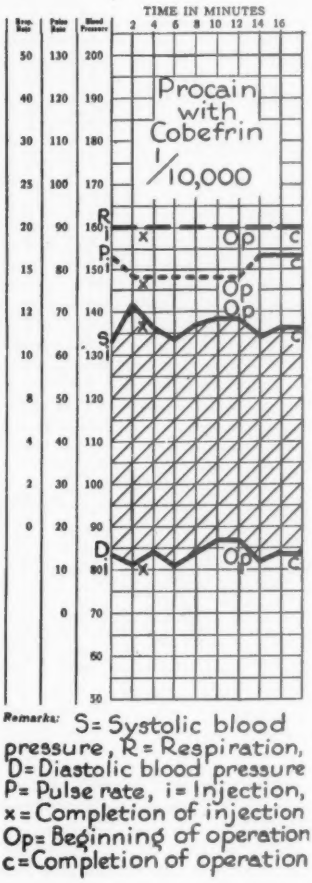

TIME IN MINUTES
2 4 6 8 10 12 14 16
Procain with Cobefrin 1/10,000
R
P
S
D
Op
c
Remarks: S= Systolic blood pressure, R= Respiration, D= Diastolic blood pressure P= Pulse rate, i= Injection, x= Completion of injection Op= Beginning of operation c=Completion of operation

Fig. 4.—Graph showing typical reactions when procaine 2 per cent with cobefrin hydrochloride 1:10,000 was used.

Neosynephrine hydrochloride has been offered as a substitute for synephrine, and apparently retains the advantage of the original compound in that it is more stable than other vasoconstrictors. These products have essentially the same action as epinephrine, but are less active in producing a constriction of the vessels in infiltration of the skin and subcutaneous tissues. Neosynephrine as a vasoconstricting agent in combination with a local anesthetic has been reported on favorably over a period of several years; but this product has not yet had extensive use in local anesthesia for dental purposes.

Cobefrin hydrochloride is a synthetic compound related chemically to epinephrine, having the same percentage composition, but with a different structural arrangement. The pharmacologic action is similar to that of epinephrine, but differs in that the vasoconstricting action is not so pronounced and the systemic toxicity is proportionally less. Solutions containing cobefrin are more stable than those containing epinephrine, but both tend to decompose on standing.

In the course of a recent study of comparative merits of vasoconstrictors in local anesthetics, we have, up to this time, obtained data concerning reactions to procaine administered in combination with epinephrine and cobefrin hydrochloride. During 300 operative sessions, with unselected patients taken as they presented themselves for dental care, such as the removal of teeth or other surgical procedures, many of the symptoms and reactions referred to above have been observed and recorded.

Our procedure was as follows: For each patient a record envelop was filed on which was entered the date, case number, name, address, age, sex, color, race, temperament, occupation and stated and apparent physical condition. Roentgenographic findings and indicated surgical procedures were noted. No attempt was made to classify patients as far as any

systemic disturbance was concerned. Consideration of the physical condition was much as is usually given in any case in which dental care is sought. Routine questions as to the physical condition showing blood pressure, pulse and respiration was prepared for each operative session. Whenever possible, patients were selected who were to have multiple extractions, in order that the effect of

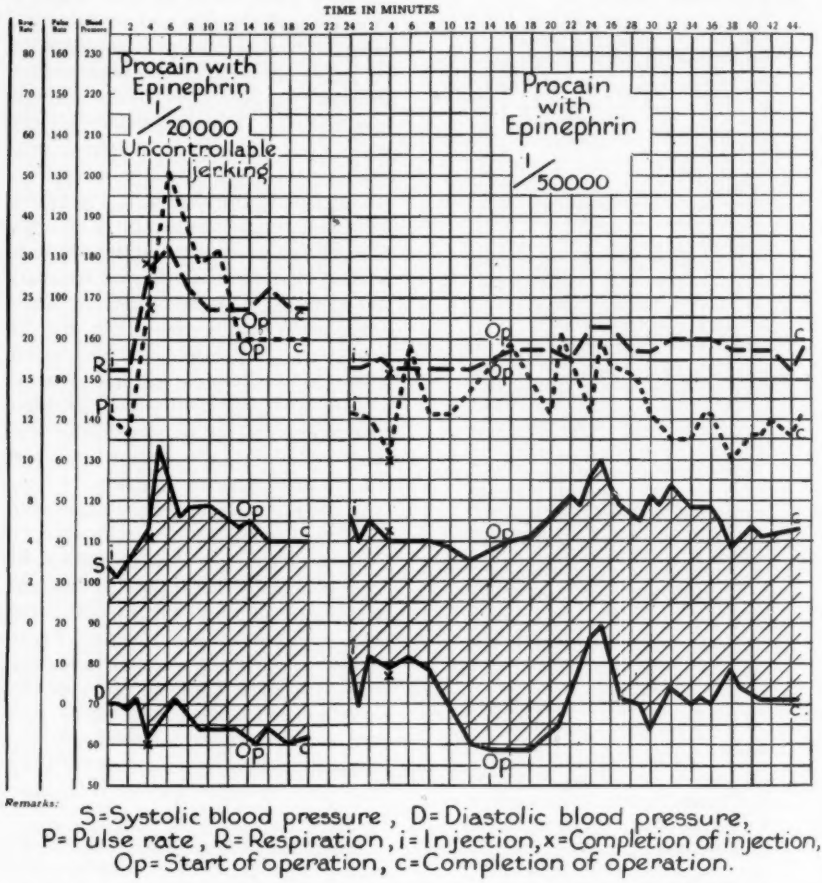


Fig. 5.—Graph showing reactions when procaine 2 per cent with epinephrine 1:20,000 was injected, as compared with procaine 2 per cent with epinephrine 1:50,000, used on a different day.

were asked and notations were made as to the patient's general appearance.

In addition, a clinical record chart the different solutions could be determined on the same patient. This clinical record showed the date, the name of the

patient and the case number, in order that all data obtained at each session could be accurately filed for future reference in the record envelop. In ninety-six cases, we were able to study the reactions of the same patient to the various solutions on different days.

The patient being comfortably seated in the operating chair, before any procedures whatsoever were undertaken, the systolic and the diastolic blood pressure, pulse and respiration were noted. These readings were repeated throughout the entire session and recorded at two-

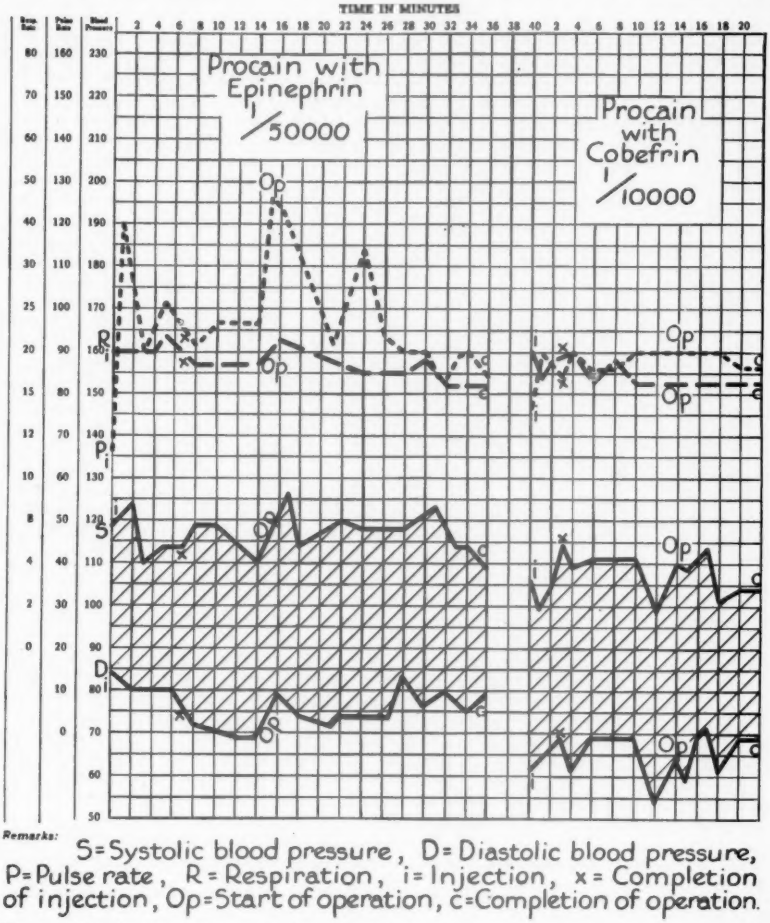


Fig. 6.—Graphs of same case as that referred to in Figure 5; showing reaction when procaine 2 per cent with epinephrine 1:50,000 was injected, as compared with procaine 2 per cent with cobefrin hydrochloride 1:10,000, used on a different day.

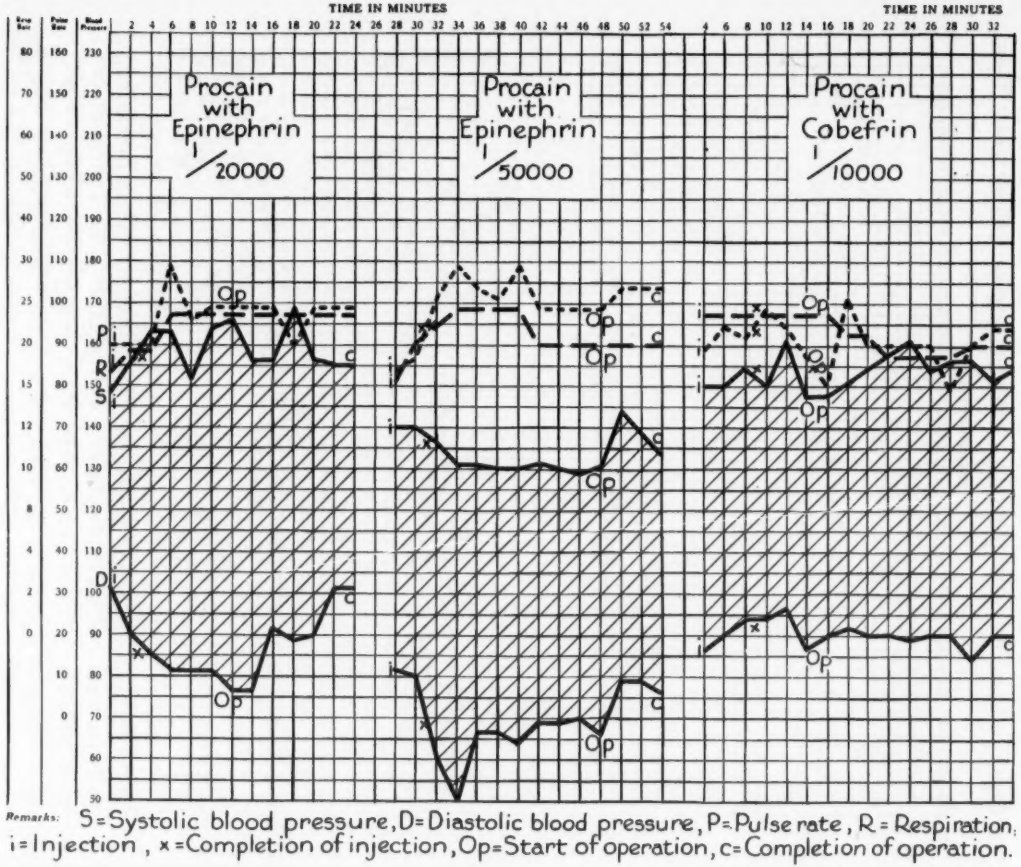


Fig. 7.—Graphs showing comparative reactions in a patient when procaine 2 per cent with epinephrine 1:20,000, procaine 2 per cent with epinephrine 1:50,000 and procaine 2 per cent with cobefrin hydrochloride 1:10,000 were injected on different days.

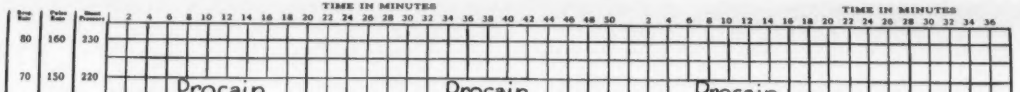


Fig. 7.—Graphs showing comparative reactions in a patient when procaine 2 per cent with epinephrine 1:20,000, procaine 2 per cent with epinephrine 1:50,000 and procaine 2 per cent with cobefrin hydrochloride 1:10,000 were injected on different days.

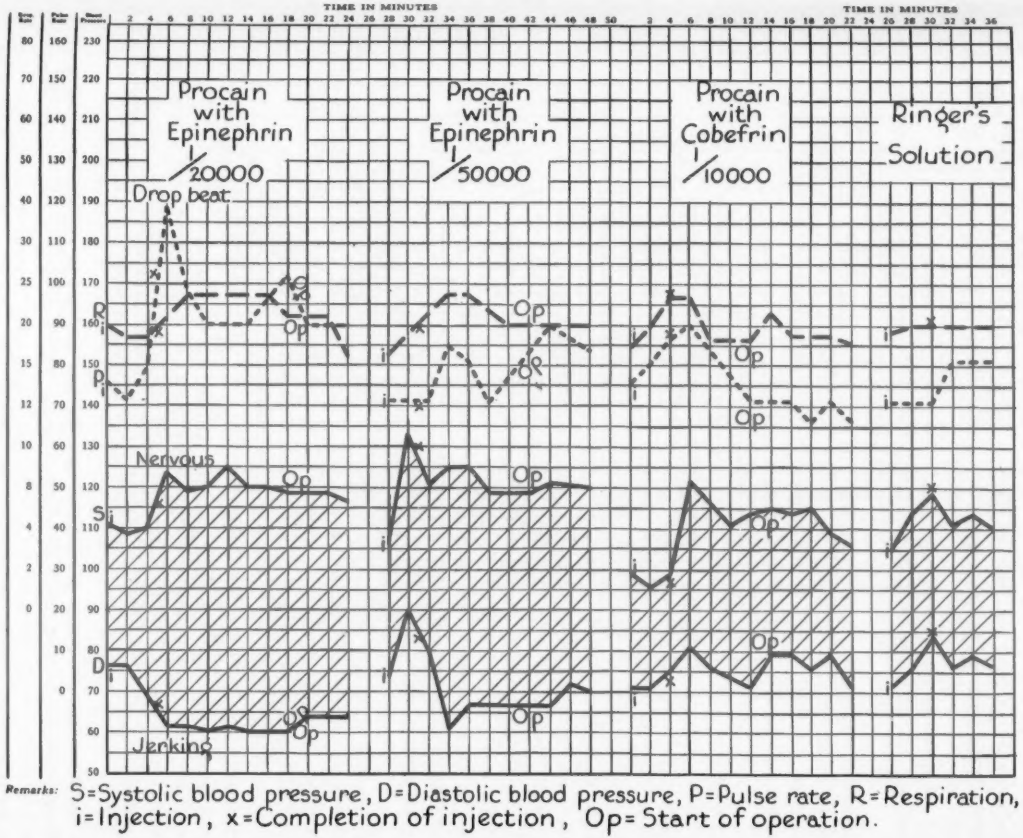


Fig. 8.—Graphs showing reactions in a patient when Ringer's solution, followed by procaine 2 per cent with epinephrine 1:20,000, was injected on the same day, as compared with procaine 2 per cent with epinephrine 1:50,000 and procaine 2 per cent with cobefrin hydrochloride 1:10,000, used on different days.

minute intervals. The time required for injection, induction and operation was noted by means of a stop watch, and indicated on the chart. The observer who made these readings was not aware as to which solution was being used.

freshly prepared or stock solution; the date obtained and the source; when the solution was prepared; the type of injection made, and the operative procedure carried out. Further notation was made as to the position of the pa-

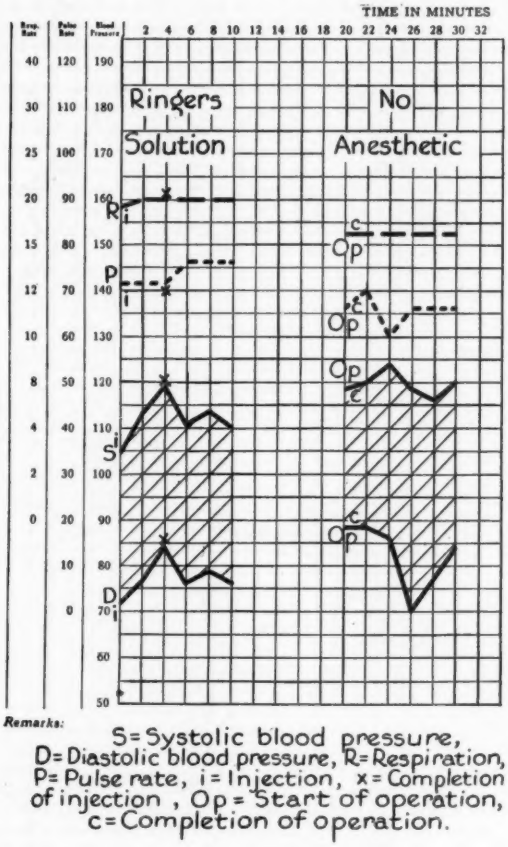

TIME IN MINUTES
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
Ringers Solution
No Anesthetic
R
P
S
D
i
c
Op
40 30 25 20 15 12 10 8 4 2 0
120 110 100 90 80 70 60 50 40 30 20 10 0
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50
Remarks:
S=Systolic blood pressure,
D=Diastolic blood pressure, R=Respiration,
P=Pulse rate, i=Injection, x=Completion
of injection, Op=Start of operation,
c=Completion of operation.

Fig. 9.—Graphs showing reactions of two different patients to mandibular injection of Ringer's solution as compared with reactions during removal of a tooth under anesthesia.

Immediately on completion of the injection, an entry was made on the chart as to the type and percentage of anesthetic solution used and whether a

tient; the time of starting and completing the injection; the total amount of solution used; the time required to produce anesthesia, and the result obtained.

Careful observation was made of the symptoms and reactions of the patient throughout the procedure.

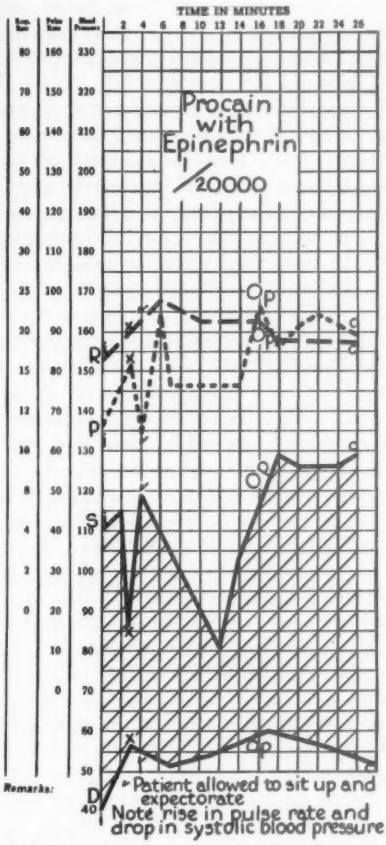


Fig. 10.—Graph showing reactions of patient who was allowed to sit up to expectorate after the injection of procaine 2 per cent with epinephrine 1:20,000.

The solutions used thus far have been: 2 per cent procaine with 1:20,000 epinephrine, 2 per cent procaine with 1:50,000 epinephrine and 2 per cent procaine with 1:10,000 cobefrin hydrochloride. Ringer's solution was injected in twenty-one cases as a control. Obviously, no operative procedures were carried out until sufficient time had elapsed for observations to be made; following which, a procaine solution was injected.

The procedure throughout was uniform, particularly with reference to the amount of solution injected and the technic followed in blocking the various branches of the fifth nerve.

In analyzing the data according to physiologic reaction, the records were separated according to the solution used. After these divisions were made, each graph was reduced to figures on the following basis: With the first readings taken when the patient was seated in the chair as a mean, the variations were computed above and below this mean. The findings in each individual record were tabulated in this manner, and the records were then grouped according to the reactions from which the percentage of variations was derived.

On the basis of the data and clinical observations recorded in these studies, we can reasonably conclude that the more diluted the solution of epinephrine with procaine used, the less tendency there is to unfavorable reaction; and that injection of cobefrin hydrochloride in combination with procaine, in sufficient amounts to produce satisfactory anesthesia, causes fewer clinical reactions than do the other solutions.

Regardless of the vasoconstricting agent employed, occasional reactions are to be expected, owing to certain factors that must be taken into consideration, such as the susceptibility to epinephrine; the temperament; fatigue; physical condition; strength and temperature of

the anesthetic solution; rapidity of injection; position of the patient in the operating chair; the environmental temperature, such as a draft of cold air; abnormal respiration; accidental injection of a solution into a blood vessel; exertion following injection, such as raising up to expectorate, and pain and shock. Knowing that any of these may be responsible for increasing the tendency toward unpleasant and sometimes alarming reactions, it is necessary to use every precaution to minimize them or prevent their occurrence. The susceptibility of a patient to epinephrine in combination with procaine is usually unknown, but, by careful observation as to type, temperament, general constitutional disturbances, etc., severe reactions may frequently be avoided.

The physical condition of the patient is an important consideration, regardless of the type of anesthesia employed. In the presence of definite heart impairment, particularly coronary sclerosis or angina pectoris, the hazard is always great and there is no absolutely safe anesthetic. If local anesthesia is used in such cases, the solution should contain a minimum amount of epinephrine or one of the weaker vasoconstricting agents. The solution should be injected slowly, at body temperature, with the patient in the recumbent or semirecumbent position. The same precautions are necessary in the presence of hyperthyroidism or arteriosclerosis. The operative procedure should be restricted to a small area that can be anesthetized by a minimum number of injections and the smallest possible amount of solution. The confidence of the patient should be gained beforehand in order that his excitement and fear may be allayed. He should be advised of the proposed procedure and of the sensations and aftereffects to be expected. In an extremely nervous patient, in whom extensive operative procedure may cause shock, some form of preoperative medication is indicated. A draft of cold air on the patient during the operation may be responsible for the development of some unfavorable reactions.

The same precautions regarding the strength and the temperature of the solution injected, the reclining or semireclining position of the patient and the rapidity of injection, never exceeding 1 minim per second, should be carefully followed in all cases, regardless of the physical condition. The maintenance of normal breathing throughout is important. Frequently, a patient will hold his breath or the breathing will become shallow, particularly with the first insertion of the needle. This results in lack of oxygen in the system (anoxemia) and very frequently is a factor in the development of some of the unfavorable symptoms. It is important to move the needle back and forth slightly while the solution is being discharged or to retract the plunger in order to determine whether a blood vessel has been entered. It is not unusual, owing to the vascularity of the areas into which injections are made for anesthesia of oral structures, to deposit the solution directly into a small vein or artery, and thereby increase the toxicity of the anesthetic solution. The act of raising up to expectorate after injection may precipitate a severe reaction. The exertion of bending forward to use the cuspidor may be avoided by supplying the patient with a small basin.

The pain resulting from a faulty injection technic or from traumatizing tissue not properly anesthetized may produce shock. Every precaution should be taken to be certain that the area is thoroughly anesthetized before the operation is started.

CONCLUSIONS

With the local anesthetic agents available at the present time, toxicity due to too rapid absorption is an ever present menace. Consequently, the use of a vasoconstricting drug is necessary to delay absorption of the anesthetic agent, thus fixing it at the point of injection. Epinephrine, cobefrin hydrochloride and neosynephrine hydrochloride are the vasoconstrictors that most nearly meet these requirements. As we have indicated, and many others have observed, the use of epinephrine with procaine is not an infrequent source of unfavorable reactions. Our findings in comparing the clinical effects of local anesthetic solutions containing 1:20,000 and 1:50,000 epinephrine in combination with 2 per cent procaine to a solution of 1:10,000 cobefrin hydrochloride with 2 per cent procaine solution may be stated as follows:

1. The more dilute the epinephrine solutions used, the less pronounced the resulting change in blood pressure, pulse rate and the tendency to untoward and disturbing clinical reaction.

2. Concentrations of cobefrin hydrochloride in combination with procaine, necessary to sufficiently prolong anesthesia for dental operative procedures, give rise to even less change in the blood pressure and pulse rate, and cause fewer clinical reactions.

We have outlined certain conditions that tend to increase the incidence of untoward reactions to local anesthetic solutions that contain a vasoconstricting agent. Careful observation of such things as the physical habitus, the nervous temperament and the general physical condition of the patient, as well as a carefully followed technic of preparation and administration of the anesthetic solution, will allow one to reduce reactions to a minimum.

CONSERVATION OF PULP-INVOLVED TEETH*

By E. A. JASPER, D.D.S., St. Louis, Mo.

THE control of caries through diet and hygienic habits, together with early treatment of carious lesions, is the ideal for which dentistry is striving. Regardless of this high aim, pulp involvements resulting from fractures and neglected caries will always occur, and it will remain our duty as dentists to determine in each instance whether the affected tooth should be extracted or retained.

Much has been written pro and con on this subject. Some time ago, Rosenow contributed another article[1] in which he advocated the removal of all pulp-involved teeth, citing a number of men in agreement with his views. Briefly, the contention of Rosenow and those who share his opinion is that streptococci can more readily be isolated from pulpless teeth than from normal teeth, and that pulpless teeth are therefore a menace

*Read before the Section on Therapeutics, Pathology and Research at the Seventy-Second Annual Midwinter Clinic of the Chicago Dental Society, Feb. 18, 1936.

1. Rosenow, E. C.: Studies on Focal Infection, Elective Localization and Cataphoretic Velocity of Streptococci, D. Cosmos, 76:721 (July) 1934.

to health and should be extracted.

On the other hand, we have an eminent group of investigators, both in this country and abroad, who take quite a different attitude. Blayney,[2] Coolidge,[3] Gottlieb,[4] Grove,[5] Kronfeld[6] and many others referred to in their writings believe that since new cementum is deposited in the apical foramina of properly treated pulpless teeth, thus sealing any interstices remaining after canal therapy, such teeth are as readily tolerated as vital teeth in which the canals have been obliterated by calcific deposits incident to old age.

The crux of the situation is, what shall we do if we remove all pulp-involved teeth? If we leave neglected spaces, there will be a shift in the alinement of the adjacent teeth, loss of contact points, impaired function and probably the development of periodontal disease as a result of all three. If replacements are made, we may cause injuries to abutment teeth that will result in the very condition we are trying to get away from. In this connection, Hatton writes[7]:

> Another type of dental infection that has received but little consideration, especially from physicians . . . is the infected vital pulp. Such conditions are too prone to occur under the type of restoration that is becoming more common in order to avoid the necessity of making pulpless teeth. Teeth carrying large inlays . . . or crowns over vital pulps are the ones that are likely to succumb to some form of tooth pulp degeneration, and only too frequently these are of an infectious nature. Unfortunately, such infections are prone to become circumscribed and cause but few clinical symptoms . . . or signs that are difficult to interpret. As in pyorrhea, their removal is likely to be associated wtih prompt improvement in the condition of the patient. Thoma, Rickert, Blaney and others have discussed this condition.

Still another phase of this same difficulty is considered by Kronfeld[8]:

> For a long time, the attention of dental practitioners and investigators has been directed to the possibility of injuries due to occlusal stress. Karoly, of Vienna, was an early observer who expressed the opinion that increased function may cause loosening and loss of teeth. In this country Stillman and McCall discussed this problem. They created the term "traumatic occlusion," which they defined as abnormal occlusal stress capable of producing or having produced an injury to the periodontium. These authors point out that one of two things will result when teeth are subjected to excessive strain: Either the supporting structures will become reinforced, thereby making the teeth able to withstand the increased functional demand, or the supporting tissues will be damaged and will break down.

Thus, it is apparent that we are confronted with a problem which we cannot lightly dismiss. To order the extraction of teeth arbitrarily without serious thought as to their replacement is neither scientific nor humane.

In recapitulating, it should be said that various restorative appliances, properly

2. Blayney, J. R.: Fundamentals Governing Pulp-Canal Therapy, D. Cosmos, 74:635 (July) 1932.

3. Coolidge, E. D.: Status of Pulpless Teeth as Interpreted by Tissue Tolerance and Repair Following Root Canal Filling, J.A.D.A., 20:2216 (Dec.) 1933.

4. Gottlieb, Bernhard; Orban, Balint, and Stein, Georg: Root Treatment in Case of Vital Pulp, Tr. VIIIth Australian D. Cong., 1933, p. 99.

5. Grove, C. J.: Essentials to Successful Pulp Canal Therapy, D. Digest, 39:465 (Dec.) 1933.

6. Kronfeld, Rudolf: Histopathology of Teeth and Surrounding Structures, Philadelphia: Lea and Febiger, 1933, p. 188.

7. Hatton, E. H.: Evaluation of Theory of Focal Infection, J.A.D.A., 21:463 (March) 1934.

8. Footnote 6, p. 354.

planned and executed, usually give a high degree of satisfaction; and this paper is certainly not intended as an attempt to discredit prosthetic dentistry. We must constantly keep in mind the diverse difficulties and dangers involved, and weigh them carefully before removing teeth. It is a sad commentary on the present situation that some of our colleagues argue that root-canal therapy is not appreciated by their patients, that they cannot obtain payment for it in proportion to other types of service and that they consequently extract teeth requiring it. I believe that every reasonable person would appreciate its value if apprised of the various factors concerned, and the necessity of doing it painstakingly if it is to be done at all.

For a number of years, certain members of the profession have earnestly striven to improve the technic of pulp removal and canal filling. Together with these endeavors, there has been a diligent effort to determine what teeth are safely operable. Out of it all has come much disappointment, but some real progress. Today, we know that the carelessness and indifference of some of our past procedures invariably invited failure, and that success is dependent on basic principles of every other form of surgery.

At Washington University, St. Louis, we are following a very definite, precise technic. It is our desire to teach the student to determine when a pulp-involved tooth may be retained, to anticipate the difficulties encountered in replacing teeth, to appreciate the importance of maintaining strict asepsis in root-canal operations, to develop a delicate sense of instrumentation, to study the action of drugs and use them intelligently and, finally, to keep in mind that the teeth are a part of the entire human mechanism, and that they may be influenced by, as well as influence, other parts. It is by no means asserted that this technic is the panacea of the day, but it does suffice to impress the student with the importance of doing this work well, if he intends to do it when he enters prac-

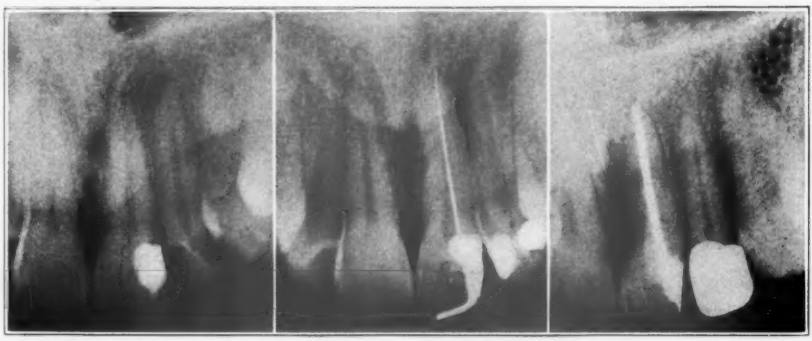


Fig. 1.—Successive steps in pulp canal filling. (Figs. 1-3.) The diagnostic roentgenogram in the center suggests the length of the measurement wire, which, with a right angle bend over the incisal edge, gives accurate information as to the length of the pulp canal, errors due to distortion in the roentgenograms being thus obviated. The completed case at the right shows the silver point occupying the full diameter of the canal as prepared by use of the corresponding file.

tice. Incidentally, it is conducive to further research on the part of those who are interested.

CASE SELECTION

In classifying cases, consideration is first given to that small group in which the pulp may be capped. The deeply decayed teeth of children, having partially developed roots and large vascular pulps, constitute this class. Before preparing the cavity in such a tooth, we ascertain whether there has been a history of pulpitis and make tests as to vitality. If there have been no severe symptoms and the pulp responds as do those of the adjacent teeth, the rubber dam is placed and the carious matter carefully removed, obtundents being used where necessary. When the pulp is exposed as a result of thorough curetment, the cavity is flushed with a warm 1 per cent chlorazene solution (chloramine U.S.P.) and then dried with sterilized cotton. This is followed by the very gentle application of a bland resin cement. The compound suggested by Brady[9] is ideal here. Over this is placed a good grade of oxyphosphate of zinc cement, and the patient is dismissed. If no unpleasant symptoms develop in the course of several weeks, a part of the cement is removed and a permanent filling inserted. On the other hand, if inflammatory changes occur, the tooth must be removed, as it could not mature in the absence of normal pulp tissue.

Pulp capping is sometimes resorted to for adult patients, but, because of the greatly restricted circulation in the pulps of fully developed teeth and the inability of such pulps to throw off infection, it is rarely successful. It is far better to remove an exposed pulp at once than to risk the chance of an extensive infection by capping.

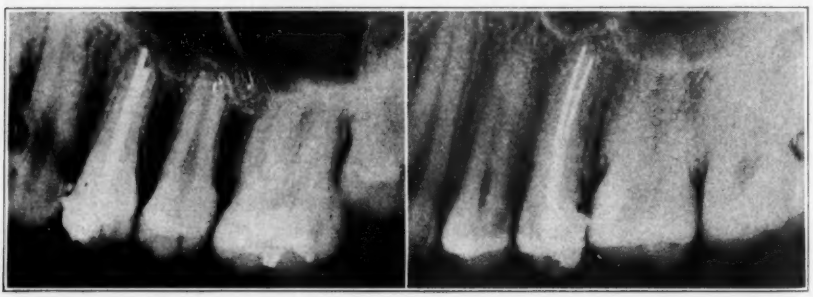


Fig. 2.—Step 2. Multirooted teeth (compare Figure 3) are filled in the same manner as incisors. The lengths of the several filling points are carefully recorded to facilitate corrections, if necessary.

In determining what cases offer a favorable prognosis for canal therapy, certain cardinal points are carefully considered. Good results cannot be expected in persons of advanced years, nor in those chronically ill. The same is true in instances of inaccessible teeth and of roots extensively denuded by periapical infection.

In considering the age factor, it should be borne in mind that the removal of a dental pulp involves an injury which only nature can repair. Certain metabolic changes will take place in the tissues of

9. Brady, E. P.: Carious Tooth, D. Cosmos, 76:1058 (Oct.) 1934.

the tooth apex after pulp extirpation, just as changes occur elsewhere in the body after the removal of a part. Since we anticipate that these changes will be curative and not necrotic, this work should be done only for patients whose recuperative power is still good.

The same applies to the factor health. If a patient's general health is below normal, normal reparative processes cannot be expected.

In studying the factor of accessibility, not only the location of the affected tooth is considered, but also the curvature of its canals. In other words, the tooth must be so accessible that we can fully clean and fill the large canals. The more thoroughly various openings are mechanically sealed, the less is required of the adjacent tissue in effecting repair.

The fourth factor, namely periapical involvement, is of particular importance. If the roentgenogram shows extensive periapical involvement, the tooth is affected by an infection of long standing. Only persons with unquestionably good

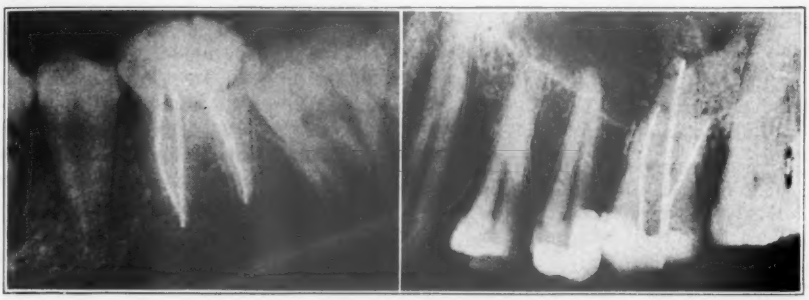


Fig. 3.—Step 3. The pulp canals are reamed and filed until good resistance is met by instruments. Filling points of the same diameter and taper as that of the last instruments used are then sealed in position. When the main canals of the teeth are thus fully filled, Nature's work of repair is greatly minimized as compared with "partial pulpectomy." Accessory canals exist in many cases, but the tissue in these canals remains healthy when not contaminated or injured by the use of powerful drugs.

Fig. 4.—Left: Periapical infection, with resulting bone involvement. This can often be eliminated through the pulp canal. Various factors must be given close attention. Right: Complete filling in of new bone.

health are considered for treatment. A roentgenographic examination of other parts of the mouth is also made, and the diagnosis based on the complete findings. As a general rule, we extract all multirooted teeth when infected, and confine our treatment to those teeth which it would be very difficult to replace, esthetically or otherwise.

PROCEDURE

The next consideration relates to technic. In this connection, Kronfeld makes several interesting observations:

Aside from infection, the greatest damage to the apical tissues can be done by the use of too powerful and harmful drugs. When root canal therapy was first being developed and practiced, strong and powerful drugs were frequently used to enlarge the root canal and to control infection. Concentrated hydrochloric acid and sulphuric acid were among the drugs recommended and used. Since then we have learned to understand and appreciate the importance of the apical tissues for the successful outcome of any root canal operation, and all these strong and tissue-destroying drugs have been ruled out. The enlargement of the canals, formerly done by acids, is now performed with sterile, clean-cutting instruments, and the necessity of using strong disinfectants has been overcome by working out a constantly improving system of asepsis. . . . When we consider these tissue reactions, we can readily appreciate the advantage of local anesthesia over arsenic trioxide for the removal of living pulp tissue.[10]

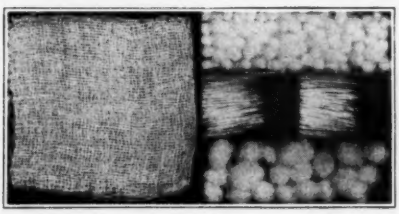


Fig. 5.—Cotton goods conveniently assembled in tray, which has a lid, and with its entire contents can be autoclaved. If an autoclave is not available, various cotton points and pellets can be sterilized as used by immersion in molten metal. (Compare Figure 7.)

Every authority, so far as I know, is in entire agreement with Kronfeld on this point. Infiltration or conduction anesthesia, produced by use of a 2 per cent procaine-epinephrine solution, seems ideal for the purpose. In cases of inflamed or aching pulps, it is advisable to seal in an obtundent and antiseptic drug for a day or two before operating. By so doing, we relieve the congestion and minimize the possibilities of spreading infection when the pulp is removed. Cresatin is very satisfactory for this purpose. It does not coagulate albumin, and penetrates deeply.

The necessity of obtaining root measurements at the very outset of canal operations is obvious, since injury to periapical tissue by mechanical means is virtually as undesirable as injury by chemical means. A fine sterile wire, previously gaged according to Black's chart of average tooth lengths,[11] may be inserted in the canal just as soon as the pulp is exposed. This wire should be secured in position with hot guttapercha, a roentgenogram taken and calculations carefully made and recorded. All instruments subsequently used should be checked accordingly. Broaches, reamers and files can be obtained in various lengths, and may be supplemented with "stops" made of minute tubing or disks.

Strict asepsis is paramount. The rubber dam is used routinely, and every effort is made to guard against infection. I cannot emphasize this point too strongly. Many seemingly perfect fillings

10. Footnote 6, p. 186.

11. Black, G. V.: Descriptive Anatomy of Human Teeth, Philadelphia: S. S. White Company, 1902, p. 16.

prove failures because infection has been carried into the canal. After the pulp is removed, canals must be enlarged so as to remove shreds of tissue adhering to uneven walls. This step should be given most careful attention, for the average root canal presents many irregularities, and a delicate instrument may be readily broken off in the tooth. Such an accident almost invariably means failure, as the broken part is usually wedged at some inaccessible point. New and tested instruments should be used. When a reamer or file binds, it should be gently pulled out of place and not twisted farther. The larger size reamers should not be used until the canal has been thoroughly explored with the smaller ones. This will prevent the formation of ledges, so readily caused by the larger and less flexible instruments and over which it is very difficult to proceed. When a canal has been thoroughly cleansed and definitely tapered, a mild antiseptic dressing should be sealed in place for two or three days. The apical tissues are thereby given an opportunity to readjust themselves, and the possibility of trapping exudate or infective material by an immediate filling is eliminated. Here again, cresatin may be used to advantage. Its analgesic action soothes the torn apical tissues and promotes healing.

We now come to a phase of this work that has always taxed the skill of the best operators; that is, accurate filling. If a canal is overfilled, the periapical tissues are impinged on. They may tolerate such impingement, if it is not too great, but the filling is certainly not ideal. Nature's work of healing is made much more difficult when foreign substances protrude beyond the apex. On the other hand, if the filling is short, short in relation to the cleansed canal, a void is left where dead cells and bacteria will collect. Trouble invariably results.

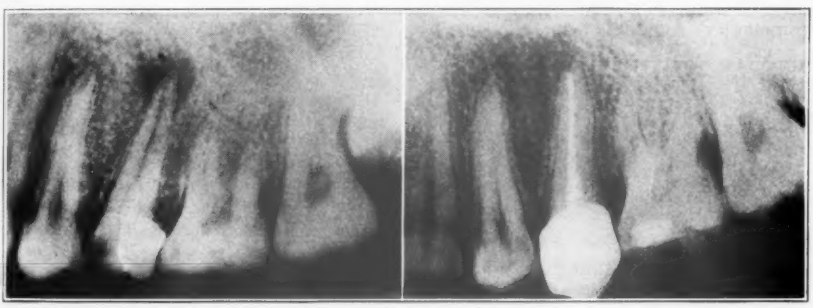


Fig. 6.—Left: Partially filled pulp canal showing periapical infection. The tooth responded readily to treatment and has since given more than ten years of good service. Right: Roentgenogram taken recently.

Again, a type of filling that is equally hazardous is the porous, or nonsealing, kind. Unless we insert a dense and well-adapted filling, we simply add to various fomites that may be present about the body, and defeat our purpose, no matter how well the other phases of our technic are worked out. Guttapercha has long been a favorite material, and is a good one when well condensed or closely adapted to the walls of the canal. It is extremely difficult to prevent overfilling during the condensing process, as guttapercha readily

changes shape under pressure. Metal cones of lead, gold or silver, used in conjunction with an impermeable sealing compound, offer the advantage of length control. Both Buckley[12] and Grove,[13] two of the foremost workers in this field, have for some time urged their use.

In my hands, metal points are much more satisfactory than other materials. There are certain objections to them as they have heretofore been offered for use. Lead cones, as suggested by Buckley, are quite brittle, and the smaller sizes are easily broken. Furthermore, the taper does not conform to that of pulp canal instruments. This fact makes it impossible to secure a good lateral fit, and too much reliance must be placed on the sealing compound. Apparently for this reason,

Fig. 7.—Electric sterilizer containing crucible in which low fusing metal can be kept in molten state. The rheostat attached enables the operator to maintain the proper temperature and avoid overheating. Immersion of cotton points and pellets for five or six seconds is ample for surface sterilization.

Grove designed gold points in accordance with a definite set of files. His technic is accurate and, if followed in detail, has excellent results. It involves a special array of instruments, the holders for which are bulky and not so easily manipulated as the standard reamers and files, which have small cylindrical knobs. Incidentally, his points conform to the taper of his instruments only.

The desire to simplify this all-important step in this work prompted me to have cones made that correspond to standard instruments. They are of silver, and are not brittle nor costly. When the preparation of a canal has been completed with a No. 6 file, for example, a cone of similar proportions can readily be placed in position. For convenience, these points are made amply long so that they may be easily removed if necessary. Our technic consists simply in sealing in place a cone of the proper diameter and taper the

Fig. 8.—Mynol dish and glass jars, which offer a convenient means of sterilizing various smal instruments. Broaches, reamers, etc., are immersed in a metaphen solution for ten minutes, then in alcohol. The dish has a center section containing paraform and a ground glass lid to retain the formaldehyde fumes. Instruments placed in the dish in a sterile condition will remain so indefinitely.

length of which has been determined by root measurements as previously suggested. A final roentgenogram is always taken to check against error. If the point extends slightly beyond the apex, it is removed and cut to exact length; if it is too short, it is removed and the canal enlarged by a few turns of the corresponding file. A resinous compound is used as the sealing agent with these silver cones. Alcohol is used routinely to bathe the

12. Buckley, J. P.: Pulpless Tooth, Its Pathology and Conservation; New Method and Technic of Filling Root Canals, J.A.D.A., 16:44 (Jan.) 1929.

13. Grove, C. J.: Simple Accurate Procedure for Filling Root Canals, J.A.D.A., 17: 1634 (Sept.) 1930.

pulp chamber and canals before filling. This is followed by the use of warm air. The sealing agent is introduced on the largest file employed in the case, and the silver point then gently placed in position.

INFECTED TEETH

The study of infected teeth presents a rather complicated picture. Here, we are faced with unfavorable conditions, not found in cases of simple pulp extirpation. The tissue in accessory canals is almost invariably infected, and the resistance of the periodontal membrane is lowered. Sometimes, the adjacent bone is affected, and the root-end denuded.

In the simpler cases, that is, when a single-rooted tooth is involved, when the patient's health is unquestionably good and when the problem is not complicated by similar infections in other parts of the mouth, an effort should certainly be made to save the tooth. This belief is based on the fact that we have seen hundreds of cases in which the periapical area cleared, and remained clear indefinitely. It is contended that such teeth are always a potential source of infection. We are not in agreement with this view. Hess[14] has shown that apical ramifications occur in a large percentage of cases, but, in single-rooted teeth, it is not over 31 per cent. More than two-thirds of all these teeth, therefore, offer the possibility of successful treatment, as the foramen can be sealed. We cannot ascertain from a roentgenogram whether branch canals are present, but we can determine from a culture whether we have eliminated the infection. When we are unable to do so, we either extract the tooth or resort to apicoectomy; our decision being governed by the location of the tooth, the amount of supporting bone, etc. Blum[15] and others believe that apicoectomy is successful in the majority of carefully selected cases. We do not have sufficient data at the present time to give a definite opinion in this regard.

A variety of methods have been advocated for the treatment of infected teeth. We find that, while many have merit, the chlorine-bearing preparations cause the least irritation and are usually as effective as the others. Our customary procedure is as follows: At the first visit, the tooth is opened, débris removed and access gained to the canals. Chlorazene (chloramine, U.S.P.), 4 per cent in distilled water, is then sealed in the cavity. This drug rapidly liberates chlorine, detoxification of much of the infected canal tissue resulting in one treatment. Its action is brief and the patient must be seen again within thirty-six hours; preferably, within twenty-four hours. At the second visit, the rubber dam is applied and the canals fully cleansed, 1 per cent chloramine-T being used freely in the process. A solution of 3 parts monochlorphenol to 2 parts camphor is now sealed in the tooth and allowed to remain from two to four days. This compound also gives off chlorine, but more slowly, and may therefore be left in the tooth for a longer period. Incidentally, it is soothing to the inflamed periapical tissues and promotes healing. Two or three treatments of this kind will frequently overcome the infection. Elimination of infection can be determined by the absence of any foreign odor and discoloration from the dressing. A culture may then be made and if it is

14. Hess, Walter, and Zürcher, Ernst: Anatomy of Root Canals of Teeth of Permanent Dentition. Anatomy of Root Canals of Teeth of Deciduous Dentition and of First Permanent Molars, New York: William Wood and Company, 1925.

15. Blum, Theodor: Root Amputation: Study of One Hundred Fifty-Nine Cases, J.A.D.A., 17:249 (Feb.) 1930; Additional Notes on Root Amputation, Including Study of Thirty-Eight New Cases, ibid., 19:69 (Jan.) 1932.

negative, the canals can be bathed with alcohol, dried and filled.

CONCLUSIONS

Capping of pulps of undeveloped teeth which appear normal roentgenographically and react normally to various clinical tests is good practice in view of their large size and abundant blood supply.

Pulp removal and canal filling in non-infected mature teeth offer a favorable prognosis when given the same exacting care that other delicate surgical operations demand.

The treatment of single-rooted infected teeth is successful in a large percentage of carefully selected cases, and is worth the effort because of the difficulties involved in satisfactorily replacing anterior teeth.

4559 Scott Avenue.

FURTHER DETERMINATIONS ON THE STRENGTH OF DENTURE MATERIALS: CONDENSITES AND VULCANITES: A PROGRESS REPORT*

By HORTON D. KIMBALL, D.D.Sc., Detroit, Mich.

IN a previous paper,[1] I described in minute detail a series of tests employed by me to measure the strength of non-metallic denture materials. It was the purpose of that paper to develop and present a standardized technic of testing which could be applied to all denture-base materials; and thereby afford an accurate means of determining and comparing the various strength properties of these materials.

Since the first report, additional work using this same testing technic has been done on a representative group of condensites and vulcanites. This present paper submits, as a progress report, the results and data obtained with regard to the strength of these various materials.

TESTS

A brief description of the tests will permit the reader to reacquaint himself with both their nature and their object.

Mechanical tests of most materials are divided arbitrarily into three main divisions: static, impact and repeated stress. A report on the fatigue of metals[2] gives a short analysis of these groups:

Static Tests.—These tests, which are usually made on the standard tension compression machines, indicate the resistance of a material to the action of a steady load or a load applied a few times. They include torsion, flexure and Brinell hardness tests. The first four treated in detail in this paper come under the heading of static tests. They are Brinell hard-

*Tests made in the Metallurgical Laboratories in conjunction with the Prosthetics Department (R. A. Kingery, associate professor) School of Dentistry, University of Michigan.

*Presented as a clinic at a meeting of the Michigan State Dental Society, Detroit, April, 1936.

1. Kimball, H. D.: Strength of Denture Materials, J.A.D.A., 23:579 (April) 1936.

2. Moore, H. F., and Kommers, J. B.: Investigation of Fatigue of Metals, Bull. 124, U. Illinois, Eng. Exper. Station, October, 1921, p. 19.

ness, modulus of elasticity, tensile-strength and flexural-strength.

Impact Tests.—These indicate the resistance of a material against shattering under a sudden heavy overload. The fifth test described in this paper deals with the impact strength of the denture materials.

Repeated Stress Tests.—These indicate the resistance of a material to progressive failure or breakage under many repetitions of a given working load. Repeated stress tests are not standardized to any extent, and practically no work of this nature has been done on amorphous or noncrystalline substances, particularly denture materials. The last test treated in this paper deals with repeated stress tests under the heading of flexure-fatigue.

In selecting and developing the various tests, an attempt was made to choose those which might duplicate as nearly as possible the stresses and strains received by a denture during actual use in the mouth. At the present time, laboratory testing must in general be done under conditions decidedly different from those encountered in the mouth. The design of the test specimen must necessarily differ from that of a denture.

It was hoped that a formula could be developed which would allow the stresses actually developed in a denture to be calculated, permitting a closer linking of the laboratory tests with the practical application.

Authorities at the University of Michigan School of Engineering who were consulted deemed this procedure impractical. The very shape of the denture itself defeated the purpose, being such a combination of inconsistently curved surfaces of varying degrees and intensities that, it was believed, no one formula would be applicable to all dentures. Accordingly, at the present time, the best that can be accomplished is to develop and standardize a laboratory testing technic and apply the data thus obtained to practice. As all the denture-base materials were tested in the same manner, it was felt that such data would have a decided value, particularly since the results obtained were of a comparative nature.

Certain of these tests may, as additional work is done in this field, be found to be of greater value than others, with the result that some of them may be discarded. Again, the technic of making them may be altered. It is hoped that a series of two or three tests may be eventually developed which will be sufficiently comprehensive to assure a reliable means of comparing the various denture materials.

In presenting this report, rather than follow the general procedure of giving a basic group classification of the denture bases, it was felt that the data would be of greater interest and would have more value to the average practitioner if the trade names of the various commercial products were given. It is not the intention to either recommend or condemn any manufacturer's product. No attempt is made to draw conclusions or to make definite statements as to the superiority of one material over another.

Denture materials, aside from the metallic bases, are classified into two main groups, thermosetting and thermoplastic. R. N. Johnson[3] has developed an excellent outline, shown herewith, which illustrates this method of classification.

The thermosetting bases, i.e., vulcanite and phenol-formaldehyde resins, are those which harden or set when subjected to the heat of the curing process. They undergo a definite chemical change during this process and are "cured" in a vulcanizer.

3. Johnson, R. N.: Modern Non-Metallic Denture Bases, Brit. D. J., 59:465 (Nov. 1) 1935.

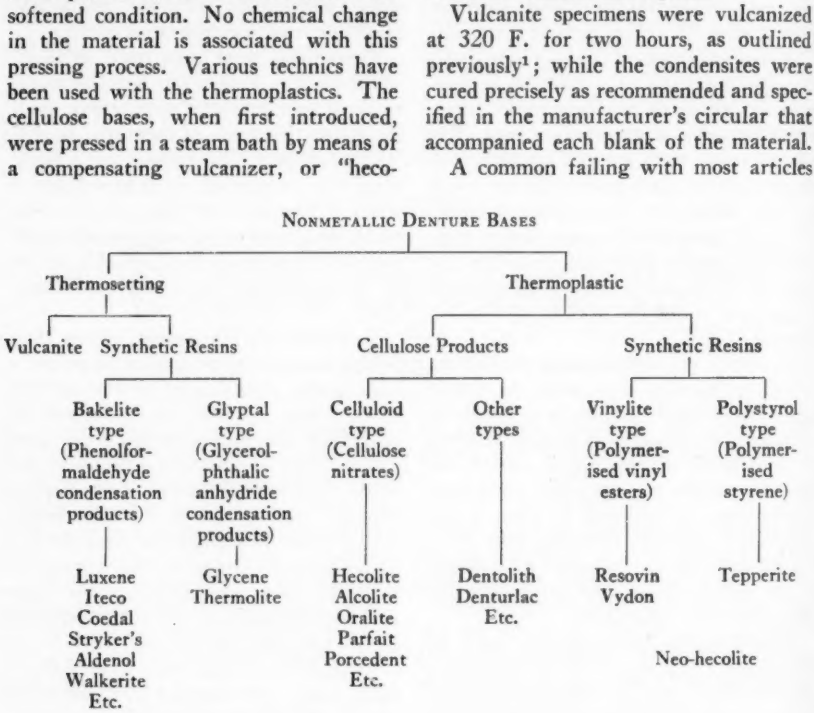
The thermoplastic bases, i.e., cellulose products and vinyl ester resins, as the name implies, become soft under heat, and are molded or pressed into shape by powerful presses while in this heated and softened condition. No chemical change in the material is associated with this pressing process. Various technics have been used with the thermoplastics. The cellulose bases, when first introduced, were pressed in a steam bath by means of a compensating vulcanizer, or "heco-lizer." The general procedure at the present time is to press them in an electrically heated press. Another method, developed more recently, and one which is applicable to vinyl resins also, is that of pressing the material in a hot oil bath. In preparing specimens for the tests discussed in this paper, the electric dry-heat pressing technic was employed.

At the present time, nine materials have been tested: three kinds of vulcanite; four synthetic thermosetting resins, and two synthetic thermoplastic resins. The vulcanites are Ashe's English Base, S.S.W. Gold Base and S.S.W. Denture "B"; the bakelite resins are Luxene, Iteco, Coedal and Stryker's; the vinylite resins are Resovin and Vydon.

Vulcanite specimens were vulcanized at 320 F. for two hours, as outlined previously[1]; while the condensites were cured precisely as recommended and specified in the manufacturer's circular that accompanied each blank of the material.

A common failing with most articles of this nature is their highly scientific manner of presentation. While such papers may contain a mass of technical data that may be of great interest to research workers, they are seldom read by the average dentist and are of little use to him if he does go to the trouble of reading them.

In the charts (Figs. 1-6) and their accompanying discussions, an attempt has been made to correlate the scientific with the practical. The charts themselves have been designed and presented in a form



In the charts (Figs. 1-6) and their accompanying discussions, an attempt has been made to correlate the scientific with the practical. The charts themselves have been designed and presented in a form

somewhat different from the customary tabular style. This was done in the belief that a clearer impression of the actual relationship of one material to another would be obtained by the reader. It was felt that the numerical values connected with the various materials in the different charts would doubtless be forgotten by the average man, but the relative position and relationship of one material to another might be retained as a mental picture.

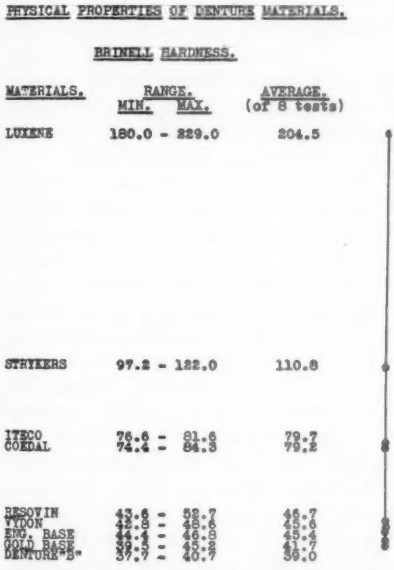

PHYSICAL PROPERTIES OF DENTURE MATERIALS.
BRINELL HARDNESS.
MATERIALS.
RANGE. MIN. MAX.
AVERAGE. (of 8 tests)
LUXENE 180.0 - 229.0 204.5
STRYKERS 97.2 - 122.0 110.8
ITECO 76.6 - 81.6 79.7
COEDAL 74.4 - 84.3 79.2
RESOVIN 43.6 - 52.7 48.7
VYDON 43.3 - 48.4 45.6
ENG. BASE 44.4 - 46.8 45.4
GOLD BASE 39.5 - 45.8 41.7
DENTURE "B" 37.7 - 40.7 39.0

Fig. 1.—Brinell hardness numbers for various denture materials.

Accordingly, the names of the materials and their numerical values have been placed in the charts in a directly proportional relationship. Thus, the reader may at a glance obtain a clear mental picture of the relative strength of any one material as compared and related to that of another. No attempt has been made to discuss the technical aspect of the tests involved. For this, the reader is referred to the initial paper of this series.[1] The values given under each chart are the average of from five to eight individual tests for every material.

PROCEDURE

Brinell Hardness.—At the present time, there exists some doubt as to the actual value and importance of Brinell hardness as far as materials for denture purposes are concerned. This is due to the fact that the question arises as to whether the stresses received by a denture when in use in the mouth are definitely related to hardness. In working out specifications and comprehensive tests for any material, it is always desirable to make as few tests as possible, and yet to have those tests cover the range of stresses to which the material in question may be

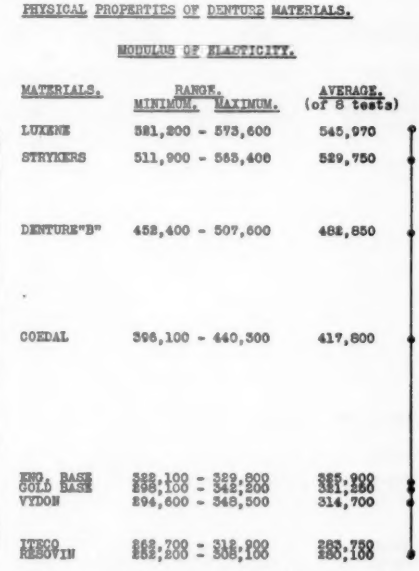


Fig. 2.—Modulus of elasticity of various denture materials in pounds per square inch.

subjected when in use. As yet, no specifications have been set up for denture materials, and as considerable variation was found in the hardness of the different bases, this test was included in these determinations. This variation in hardness is shown clearly in Figure 1.

It is of interest to note the extreme hardness of the phenol resins, as compared with the vinyl resins and the vulcanites, which, in turn, very closely approximate each other in hardness. In fact, there is considerable overlapping here, as will be seen by comparing the "range" of these materials. The hardness of the vulcanites and vinyl resins is so similar that, for all practical purposes, it may be considered identical.

PHYSICAL PROPERTIES OF DENTURE MATERIALS.

TENSILE STRENGTH.

MATERIALS.	RANGE. MIN.	MAX.	AVERAGE. (of 6 tests)
RESOVIN	6,435 -	7,295	6,912
VYDON	6,050 -	7,077	6,635
GOLD BASE	6,303 -	6,953	6,628
ENG. BASE	6,016 -	6,721	6,374
DENTURE"B"	2,669 -	3,435	3,052
LUXENE	2,209 -	3,062	2,536
ITECO	1,971 -	2,709	2,298
STRYKERS	1,418 -	2,012	1,533
COXDAL	1,247 -	1,759	1,289

Fig. 3.—Ultimate tensile strength of various denture materials in pounds per square inch.

Modulus of Elasticity.—As with Brinell hardness, the same questions arise as to the value and merit of this particular measurement. Yet it is felt that this test is of importance because certain men prefer a quite rigid base, while others prefer one less rigid. This test is, of course, a measurement of stiffness; and the higher the modulus, the stiffer the material. Again, in determining the degree of stress to apply to a material in the flexure fatigue test, the modulus of elasticity must be known. For these reasons, a chart comparing the modulus of the various materials is shown in Figure 2.

It will be seen that, in general, though there are certain exceptions, the phenol resins have a decidedly higher modulus of elasticity than the vinyl resins and the vulcanites and are, of course, stiffer.

Tensile Strength.—A test of tensile strength is a commonly accepted method of measuring and comparing the strength of materials. It has, moreover, a practical application in denture work. The reader has noted that, in a large number of fractured upper cases, the initial break occurs in the anterior region, somewhere between the two cuspids. When this break occurs while the patient is eating or chewing, tensile strength is an important factor; for when biting stress is applied to the posterior teeth, it is transmitted to the anterior part of the denture, where it becomes a tensile stress, owing to the curving of the anterior palatal portion of the denture.

Figure 3 illustrates the comparative tensile strength of the different bases tested. It is of interest to note the close relationship between the vinyl resins and two of the vulcanites. A decided difference will be seen between the tensile strength of these four materials and that of the phenol resins and remaining vulcanite, which are decidedly weaker.

Flexural Strength.—Flexural strength

was formerly termed "transverse loading." The machine used was designed by M. L. Ward, of the University of Michigan College of Dentistry, and the test is considered to be an excellent one for use in comparative testing of the denture materials. It applies a load flatwise to the middle of a test specimen that is supported at both ends. The load is increased gradually until the specimen breaks. Two things are thus accomplished by this machine: (1) one dial records the force required to break the specimen, and thereby indicates the flexural strength of the material tested, and (2) another dial records the distance that the specimen bends up to the point at which it breaks, and so indicates the degree of flexibility of the material.

These two points are illustrated in Figure 4. The vertical axis records the flexural strength, or maximum fiber stress in pounds per square inch; while the horizontal axis indicates the flexibility, or degree of deflection in thousandths of an inch.

The extreme degree of deflection and high fiber stress of the vinyl resins will be immediately noted. It will be further noted that the degree of flexibility of two of the vulcanites was practically the same as that of the vinyl resins, although their fiber stress, or flexural strength, was decidedly less. It is interesting to note still further that the flexural strength of three of the phenol resins closely approximated that of the foregoing vulcanites, yet their degree of flexibility was very much less.

PHYSICAL PROPERTIES OF DENTURE MATERIALS.

FLEXURAL STRENGTH.

MATERIALS.	RANGE. MIN.	MAX.	AVERAGE. (of 8 tests)	DEFLECTION.
RESOVIN	16,710 -	16,760	16,735	0.206
VYDON	16,060 -	16,860	16,460	0.192
LUXENE	12,370 -	13,120	12,715	0.092
GOLD BASE	12,110 -	12,980	12,545	0.198
ENG. BASE	11,430 -	12,120	11,883	0.227
STRYKERS	10,960 -	12,160	11,705	0.0505
ITSCO	10,340 -	12,750	11,702	0.0612
DENTURE"B"	8,225 -	9,042	8,633	0.069
COKDAL	5,871 -	6,211	6,028	0.048

Fig. 4.—Flexural strength in pounds per square inch (vertical axis) and average deflection in inches (horizontal axis) for various denture materials.

Impact Strength.—As has been men-

tioned before, impact tests indicated the resistance of a material against shattering under a sudden heavy overload. It is comparable to the shock received by a denture when it is dropped, and it is a measure of the degree of brittleness of the material. As will be seen in Figure 5, the phenol resins are the most brittle of the entire group. One of the vulcanites ranked very high in impact strength, and one of the vinyl resins would not break in the impact machine. The other vinyl resin broke quite readily, and could be compared somewhat with one of the remaining vulcanites.

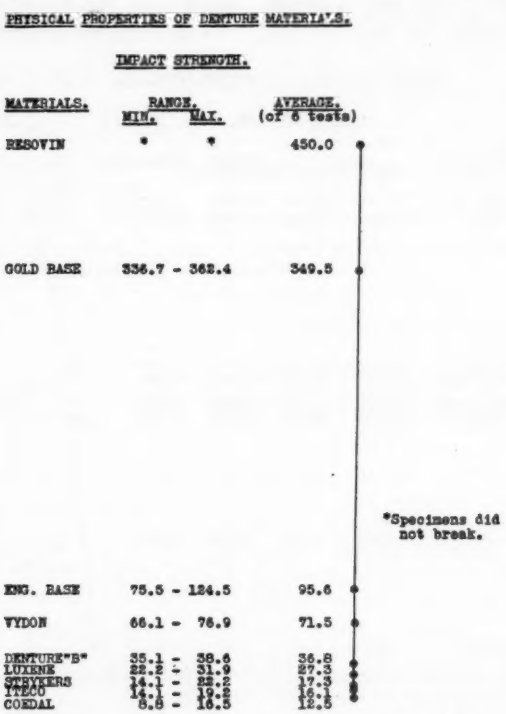


Fig. 5.—Ultimate impact strength for various denture materials in inch pounds per inch.

Flexure Fatigue.—As this particular field is so vast, and there is so little known about the nature of fatigue of amorphous substances, such as denture materials, it is impossible to draw any definite conclusions concerning this property at the present time. Flexure fatigue may be considered a measure of the "life" of the material. In this test, by the use of a special machine, the specimen is flexed forward and back through a very small arc until it becomes "fatigued" and breaks. The action is somewhat comparable to the flexing through the palate of a denture in biting under stress in the mouth.

The subject of flexure fatigue is a specialized study in itself, and much work

remains to be done along this line.

The data in this present paper were obtained by flexing all specimens of all materials the same degree. This procedure is somewhat open to criticism, but as values derived from these tests are all comparative, it did not seem unfair to the various materials to adopt such a procedure.

It is on the subject of applied stress that criticism is apt to fall. Many workers feel that the same stress should be applied to all materials. This would be accomplished by varying the amount of flexure for each one to the proper degree. The question arises as to how much stress to apply. It is hoped that the present work will be considered more as a starting point, and not as an attempt to prove anything of a definite nature.

The "thrust," or arc through which the test specimens were flexed, was 0.075 inch.

PHYSICAL PROPERTIES OF DENTURE MATERIALS.

FLEXURE FATIGUE.

MATERIALS.	NUMBER OF FLEXURES. MINIMUM.	MAXIMUM.	AVERAGE.	STRESS.
ENO. BASE	*	*	10,000,000	2,817
GOLD BASE	*	*	10,000,000	2,782
LUXENE	62,140 -	*	6,745,000	3,986
RESOVIN	200,700 -	*	1,495,000	2,260
VIDON	131,140 -	710,510	356,350	2,676
DENTURE"B"	67,000 -	679,550	270,000	4,092
STRYKERS	1,010 -	691,060	236,100	4,859
ITECO	5,650 -	92,740	20,420	2,450
COEDAL	460 -	11,580	5,654	3,450

*Specimens remained unbroken after 10,000,000 flexures.

Fig. 6.—Number of flexures for various denture materials (vertical axis) and stress in pounds per square inch applied to them (horizontal axis).

It is intended to enter more thoroughly into this subject in the future, as time permits. An attempt will be made to determine the endurance limit of each material. With the particular machine used in making this test, variation made in the "thrust," or degree of flexure, of the test specimen also changes the stress or force applied to them. As this work progresses, a series of tests will be made on all the materials, using the different stresses by altering the arc. In this manner, it is hoped to obtain some data which will be truly conclusive.

It might be stated here that the specimens were flexed from a rest position through an arc and back to the rest position. No reverse bend was given to them. In other words, a direct, rather than an alternating, stress was applied. This is somewhat more comparable to the stress received by the denture in the mouth. In Figure 6, the vertical axis illustrates the number of flexures endured by each one before breaking, the horizontal axis recording the average stress applied to each material.

Of primary interest is the endurance of the material, particularly that of two of the vulcanites. These both underwent more than 10,000,000 flexures without breaking. Since it has been estimated that one bites approximately 500,000 times a year, that would be, roughly, the equivalent of more than twenty-four years' wear, and doubtless accounts in part for the longevity of vulcanite dentures in general.

It will be of interest to note further that one of the phenol resins averaged over 6,000,000 flexures before breaking; while the vinyl resins and remaining phenol resins, with the remaining vulcanite, fell far below this mark.

CONCLUSIONS

The phenol resins were found to be the hardest of the group, the vinyl resins and vulcanites being very much softer, and also very much alike in their hardness.

The phenol resins were, in general, the stiffest of the group; with the vulcanites next and the vinyl resins the least stiff. Certain exceptions are noted to this general rule, as may be seen in Figure 2. No apparent reason was found for this variation.

The vinyl resins were the highest in tensile strength, although two of the three vulcanites were practically as high; while the third was decidedly lower, and the phenol resins the lowest.

The vinyl resins had the highest flexural strength, and were the most flexible. Several of the specimens bent to the limit of the machine without breaking. One of the phenol resins was found to be next in strength, though decidedly lower in flexibility. Two of the vulcanites had very nearly the same high flexural strength as that one phenol resin, and were also as flexible as the vinyl resins. The remaining materials were decidedly weaker and also less flexible.

The phenol resins were all very brittle, while the vulcanites and vinyl resins were much less so. An interesting fact was here noted in that one vinyl resin did not break at all in the machine although the other one did.

Two of the vulcanites had an infinite fatigue limit, being intact after more than 10,000,000 flexures; while the third one broke after an average of 270,000 flexures. One of the phenol resins was found to withstand an average of more than 6,700,000 flexures. The two vinyl resins averaged much less, and the remaining phenol resins even less.

SUMMARY

As was stated in the title, this paper has been in the nature of a progress re-

port, and the data presented herein are not to be regarded as conclusive. It was believed that sufficient material of interest and of value to the profession had been gathered to warrant its presentation in this form. A vast amount of work must still be done, and as more data and information are obtained, they will be forthcoming in similar form.

514 Chalmers Avenue.

BILATERAL SINUSITIS: REPORT OF CASE

By EDMUND BRANOWER, D.D.S., New York City

THE maxillary sinus, or antrum of Highmore, is more prone to disease than any other sinus, owing to its large size and poor facilities for drainage, and the fact that it can be infected not only from diseased teeth, but also by a chronic catarrhal condition of the nose brought on by numerous head colds and likewise by drainage from the frontal and ethmoidal sinuses.

While we are not concerned with the antrum infection due to nasal conditions, as that is usually taken care of by a rhinologist, and is very often cleared up by lavage through a puncture in the middle meatus, we are concerned with any infection having a dental origin.

Although it is usual for the upper bicuspids and first and second molars to fit into the antrum, there are cases wherein the antrum is so large that it extends to the anterior teeth, including the central and lateral incisors and cuspids and reaching the third molar, so that any one of the upper teeth, when badly diseased, may cause the infection to extend into the floor of the maxillary sinus.

Infection of the sinus may be accidental, anomalous or due to chronic infection. The accidental type occurs either in the molar or first bicuspid region, when, in trying to elevate a fractured root, the surgeon forces it into the sinus. Nearly all such accidents can be avoided by study of the case. When the fractured root is imbedded in the heavy bone of the alveolus, it is much more practical to make a buccal flap by means of a mallet and chisel, remove sufficient bone around the root to elevate it, and then replace the flap and suture. A very careful extracter may even resort to the use of a No. 700 cross-cut bur and drill away sufficient bone around the root to permit the insertion of a finely pointed elevator, thus removing the root without resorting to the flap method. The employment of the buccal flap remains the safest course. The mere use of an elevator, backed by force only, will often result in pushing the root into the sinus. This may happen in the removal of an impacted upper third molar, when, in trying to grasp it, the surgeon accidentally forces it into the sinus.

The anomalous type is due to the presence of an impacted third molar in the sinus. Such a case was recently described by an oral surgeon in which there was extreme neuralgic pain, with loss of sight and hearing, on the side of the impaction.

Chronic infection may be caused by abscess of any of the upper teeth continuing for a long period, with pus perforating and infecting the floor of the antrum.

REPORT OF CASE

A man, aged 25, of healthy appearance, was referred to have all the upper and certain of the lower teeth extracted. These teeth were in no way painful, but were badly decayed and so ugly that the patient was very self-conscious while conversing.

Roentgenographic examination of the upper teeth revealed a cyst in each maxillary sinus, but it was hoped that the floors of the sinuses would recede to allow for the formation of the cysts over the roots of the teeth without involving the sinus, which occasionally does happen.

On removal of the upper right cuspid, first and second bicuspids and first molar, an enormous opening into the sinus was found, with a dentigerous cyst about the size of a guinea-hen's egg. The cyst was removed, together with the necrotic bone and tissue, and the area curetted. This was followed by irrigation with physiologic sodium chloride solution, after which the sinus was closed with six sutures.

The patient was seen for five consecutive days. On removal of the sutures on the fifth day, a small opening was found near the second molar, which there had been hope of saving. It was then decided to extract the upper right second and third molars, which allowed traction of the mucoperiosteum from both the buccal and palatal sides, and again close the wound. Immediately, an impression was taken with elastic impression compound for an edentulous vulcanite plate to act as a rest for the tissues, and thus induce quicker coaptation of the opposite sides.

The upper right side seemed to be healing nicely, and the patient stated that he felt neither liquid nor air entering the right sinus. It therefore seemed that the second operation would be successful. Extraction of the remaining upper teeth was postponed for a month, during which time certain of the lower infected teeth were removed.

Later, the upper left teeth from cuspid to third molar were removed, the same condition being found as on the right side.

The same technic was followed in removal of the cyst, with curettement, and closure of the sinus with sutures. Immediately, an impression was taken in elastic impression compound for an edentulous vulcanite plate.

The left side closed perfectly, and remained so after the sutures were removed, while the right side opened again in the first molar area. An anteroposterior roentgenogram was then taken of both sinuses, the left one being found perfectly clear, while the right sinus appeared cloudy.

Condition revealed in roentgenographic examination.

Finally, the case was referred to a rhinologist, who punctured the right antrum below the middle meatus, irrigated the sinus and kept it clean with iodoform dressing. I freshened the walls of the opening on the palate from time to time by means of a curet and, after about three weeks of this cooperative treatment, the opening filled in with new tissue and remained closed.

The temporary denture was then discarded, the anterior teeth were extracted, and after proper healing, a full vulcanite denture was inserted.

20 East Fifty-Seventh Street.

ADVANTAGES AND DISADVANTAGES OF THE USE OF GLASS AS A DENTURE BASE

By FRANK LOTT, D.D.S., M.Sc. (Dent.), Toronto, Canada

WHEN work was commenced slightly over nine years ago on the problem of producing denture bases of glass, certain inherent properties of this material very obviously indicated it for application in this field. For instance, it was known to have wonderful hardness, tenacity and general stability, which, in the past, had been processed into many forms by various methods.

It was capable of extremely wide color variation, and a color, once established, would be of a permanence so far quite unknown in denture bases.

In addition, types of glass were known that would adhere to porcelain and various metals. Thus, it was reasonable to hope that one could be developed to adhere to porcelain teeth and, later, to metals for partial denture work.

The prospect was very inviting indeed.

Color is one of the most important of the requirements: indeed, it is felt by many operators that the general dissatisfaction of profession and patients with regard to the very unnatural appearance of vulcanite was the first great incentive toward improvement in denture bases. That color still holds this important place seems to be well proved by the fact that invariably the first question asked when the subject of a new denture base is under discussion regards its color.

It is felt that the color of the present glass satisfactorily matches that of gum tissue for the great majority of patients. The accuracy of the selection and any possible superiority over vulcanite or other bases remain open questions awaiting the answer of each individual operator.

The important quality of color in glass is the stability of it. It is established in the glass by the thorough incorporation of metallic oxides, and even remelting will not alter it appreciably. This is very important in reprocessing, as it is in the repair and alteration of dentures. One denture, for instance, was altered four times with no apparent change in color from that of a control piece from the first firing. Thus, color, as far as glass dentures are concerned, may be regarded not as a fleeting property, but rather as a permanent one. So well does this condition hold, in fact, that glass from the waste ditch of one processed denture can be thoroughly cleaned of mold material and used in the next denture with no discernible demarcation line; or the denture from a mold that has been insufficiently packed can simply be rewaxed and processed again without change in the original color.

Light does not change it in any way. Thus, a dealer will not have to store it in a dark place; rather, he will be able to place new material or a denture on display without fear of having it fade.

Moisture does not affect the color before, during or after processing. The unused glass does not even have to be kept clean. It can be washed or acid treated, if necessary, to remove dirt be-

fore it is packed in the mold. Dehydrating or tinfoiling are unnecessary to prepare the latter for processing.

No salivary content, food or orally administered drug affects it. Also, it is not acted on by any drug, such as a disinfecting solution, to which it may be exposed when out of the mouth.

Several stability features other than those associated with color are also interesting. Physically, a correctly annealed glass denture is as free from internal strain as any commercial glassware. This means that the patient will be able to leave a denture on a hot stove-shelf by mistake or even boil it for sterilization purposes without wondering later why it will not fit. Distortion simply does not occur under such circumstances, to any discernible degree. Chemically, there is no deterioration of the unused material. In other words, the shelf-life ceases to be a source of worry. Thus is eliminated a particularly serious problem for the dealer who must buy a quantity to get a price or who must import it to far distant Australia, for instance, and thereby subject it to a long journey under varying atmospheric conditions.

Translucence is a property that can well be discussed in close association with color. Vulcanite has always been criticized because it has a dead, opaque appearance, and this objectionable feature was listed as one to be eliminated in the new material, if it was at all possible.

During development, certain batches of the glass were made with much greater translucence, but it was immediately observed that the necks of the teeth were objectionably apparent. Therefore, the opacity had to be increased to a point where the underlying porcelain could not be seen.

Dental opinion usually enumerates translucence among the desirable qualities in a denture base; but it is apparent from the foregoing that a very slight amount only can be tolerated and that glass possesses it almost to perfection.

The strength of glass is another interesting factor because it varies so widely in its different divisions. In tension and compression, the values are enormous, 10,000 pounds per square inch or more, and very greatly exceed the mouth requirements. On the other hand, impact, shear and other stresses are almost impossible to compare with the mouth requirements because of the difficulty of approximating the load. For this reason, dentures have simply been tested in the mouth; for, regardless of all possible comparisons, such service will furnish the most conclusive information on the behavior of the base under actual conditions. To date, results of these tests have been quite satisfactory.

But this relatively low impact value is a disadvantage when the denture is out of the mouth, because fractures of most bases due to falling from a patient's hands are quite common. In this connection, glass is probably no better and no worse than the other bases. The ease with which it can be repaired is probably the most pleasing feature of the situation and, in addition, it may not be too much to hope that shatter-proofing may be accomplished in denture construction as in other glass work.

The thermal conductivity of glass is of a high order. Dr. Sullivan, in an article on the properties and the field of usefulness of glass, in describing the use of glass dishes for baking, etc., writes[1]: "Heat conductivity, of course, is far below the metals. However, in consequence of surface conditions heat transfer through a copper condenser is only

1. Sullivan, E. C.: Many Sidedness of Glass, Ind. & Eng. Chem., 21:177-185 (Feb.) 1929; Glass Characteristics, Corning Glass Works reprint, 1929.

two and one-half times that through a Pyrex condenser."

Thus, although the heat conductivity value of glass is only rated as 0.3 per cent that of copper, the reflecting power of the former is so low comparatively that it practically overcomes the great advantage of the metal in this regard. It is, therefore, quite superior to most of the present-day denture bases.

The welding ability of glass seems almost perfection. In the first place, a denture can be made of any number of pieces. These weld into an absolutely homogeneous mass in which demarcation lines are but faintly, if at all, visible. Further, the glass welds perfectly to the teeth. Sections cut from experimental dentures of clear glass show a true seal under the microscope. So effective is this union that no pins or undercut depressions are required in the teeth for anchorage.

In the repair of a denture, no dovetails or other preparation of the pieces are required. A clean fracture can be repaired by simply preventing any of the mold material from penetrating the crack during flasking of the case and then processing it at the correct temperature. Repairs with deficient spots are waxed without undercut of any kind and flasked. Glass is packed in the deficient spots after separation of the mold and the case is processed as before. Not only will there be a perfect union of the pieces, but also no demarcation line may be apparent.

Relining of an ill-fitting denture, a process given up for the reason that rubber cannot be vulcanized to a feather edge, will again be possible because glass will weld in sections of any degree of thinness.

There is no doubt of the decided superiority, as to this property, of glass over materials that require dovetailing or tinfoiling, show junction lines or refuse to join at all.

Elasticity is a totally different property in glass from what it is in some of the other denture bases. Such a hard, brittle material cannot be expected to show much deformation between the elastic limit and the ultimate strength. Scholes,[2] in a practical book on formulas, properties and general technology of glass, gives the elasticity as about 0.1 per cent and the Young's modulus as 10^7 pounds per square inch. On the other hand, its enormous strength in compression and tension seem to guarantee that any intra-oral load will be well within the elastic limit. This condition is quite satisfactory because dental work does not require a base that will yield readily.

Many operators seem to feel that fracture is obviated by the use of a material that will bend rather than break. While this may be true, it must also be remembered that a flexible material causes local pressure, with the subsequent occurrence of absorption. Thus, the rigidity of glass is really an advantage. Indeed, this is a reaction commented on by patients wearing glass dentures.

One man described the wearing of a flexible denture as comparable to putting one's foot, while walking in the dark, on something that gives way. The instant reaction of insecurity is quite the opposite of the feeling of solidity as pressure is put on a glass base.

The specific gravity of glass is a factor worthy of discussion. It is generally felt that the weight of a denture should be just as little as possible, more especially, perhaps, in the maxillary restoration.

The density of this particular glass is 2.5. This is for comparison with pink vulcanite at from 2.30 to 2.60 and red, maroon and dark elastic at from 1.15 to 1.19. This means an increase in weight

2. Scholes, S. R.: Modern Glass Practice, Chicago: Industrial Publications, Inc., 1935.

of a denture of perhaps 30 per cent, probably a difference of from 3 to 4 dwt., or one-fifth ounce, in an average case.

It is my opinion, borne out by the test cases to date, that this feature will cause no trouble in the great majority of cases. As an example, one extremely thick lower glass denture comes to mind that has been worn for about two years without comment on this feature. There might occur cases wherein an operator might be obliged to consider it as a disadvantage.

One of the popular questions by the dentist regarding a base material is as to whether it is sufficiently hard to take and maintain a high polish. A quotation from a technical booklet by a glass company states very well the case as to the hardness of glass[3]: "The surface hardness is but three points below that of the diamond and the exceptionally smooth, non-porous outer skin will resist certain kinds of abrasion even better than will a surface of steel."

A most beautiful polish can be given a denture without great difficulty; in fact, it seems so superior to the requirement that it advertises itself by its winking brilliance. For this reason, very little mechanical polishing is done and this is confined to labial and buccal flanges. An acid dip is sufficient for the palate. The permanence of this polish is of a high order not only because of this extreme hardness, but also because of the stability and imperviousness.

Truly, vulcanite is no match in its ability either to take or to maintain a high polish.

Glass is completely impervious. The fact that it welds to the teeth precludes even the entrance of bacteria between porcelain and glass. In addition, it is quite homogeneous. The surface does not crack nor craze as does that of glazed ceramic materials, and moisture and deposits can, therefore, secure no foothold. To this quality, add those of stability and hardness, and the result is a base of unrivaled impenetrability.

A glass denture base is quite odorless and tasteless, and when one thinks of its imperviousness and the fact that it can be sterilized by boiling, the fact is immediately apparent that it is much more likely to remain so than are other bases.

The coefficient of expansion is remarkably low. Actually, it is in the neighborhood of 70.4×10^{-7} per degree centigrade. This is seen to be a very desirable feature when one recalls the great volumetric change of rubber and the numberless dentures that are ill-fitting because of lack of care on the part of the operator.

The working properties are all that can be desired. The technic is practically identical to that employed with vulcanite during the flasking, boiling out and packing processes. No tinfoiling is required. Pressing is simple and not critical. Recovery of the denture from the mold material and its subsequent trimming and polishing involve very few departures.

Extra equipment consists of a furnace with a nicochrome resistor and a flask of heat-resisting alloy. The cost of these items and that of the glass itself will not be prohibitive.

No assertion is made that glass is ideal as a denture base. Rather, I have attempted to be accurate in describing the advantages and disadvantages of glass as understood at the present time. This point is worthy of emphasis because knowledge is constantly increasing as experiment proceeds. In this connection, it is interesting to note that a bulletin written in April of this year is already

3. Physical Characteristics of Pyrex Ware, Corning Glass Works literature, p. 12.

considerably out of date as regards equipment, technic, etc.

For this reason, the last paragraph of this bulletin[4] might be quoted in closing:

> There are so many unsolved problems that the author feels that the present work should be submitted more or less as a progress report. Help is needed for the perfecting of the technique, equipment and supplies, the invasion of the field of partial denture prosthesis and other problems that might easily come to mind. To all those who like to pioneer the way, the subject of the use of glass in denture prosthesis is suggested as a very worthy one.

4. Lott, F. M.: Glass as Denture Base, Toronto: Canadian Dental Research Foundation, 1936.

RECORD KEEPING AS AN ASSET TO PRACTICE*

By O. W. BRANDHORST, D.D.S., St. Louis, Mo.

IN the business world, assets are looked on as tangible goods that may be used in payment of one's obligations. The term is used here to denote a similar attitude in conjunction with a practice; namely, tangible things that would make for a successful practice, so that one could meet his obligations.

Record keeping in some form is associated with every practice. If it is neglected, the degree of success in such a practice is very low. In spite of the direct ratio between record keeping and successful practice, there is a great difference between records that are usually kept and those that can be kept to advantage. One person has an appointment book, supported by diagrams and slips, on which he depends for his information. Another gives this question of record keeping special attention, having an extensive system, which may or may not be efficient.

It is in the hope of stimulating interest in office records that this paper is presented. It is offered by one who may appear to be overzealous about this matter, but who does not lose sight of the fact that the time element for record keeping is an important one. Any suggestion, therefore, must be weighed in the scale of the importance of the record, the time consumed in making it and the accessibility in use.

To define record keeping, one might say that it is the recording of facts for future reference, whether they be of treatment, diagnosis, experiences, services, charges, payments, income or other factors in the practice of our profession.

When we think of records, our first thoughts are of written records, although this is only one of several forms. In addition, we may have records of conditions in plaster, by photograph or roentgenogram, by charts or graphs. Each of these has its definite place and is of infinite value in many cases. The degree to which several or all of these are used depends to a large extent upon the dentist, his work and his particular inclination or desire for such records. One person may be content to make his records solely by writing them on proper forms, while another may wish to supplement

*Read before the Section on Periodontia at the Seventy-Seventh Annual Session of the American Dental Association, New Orleans, La., Nov. 6, 1935.

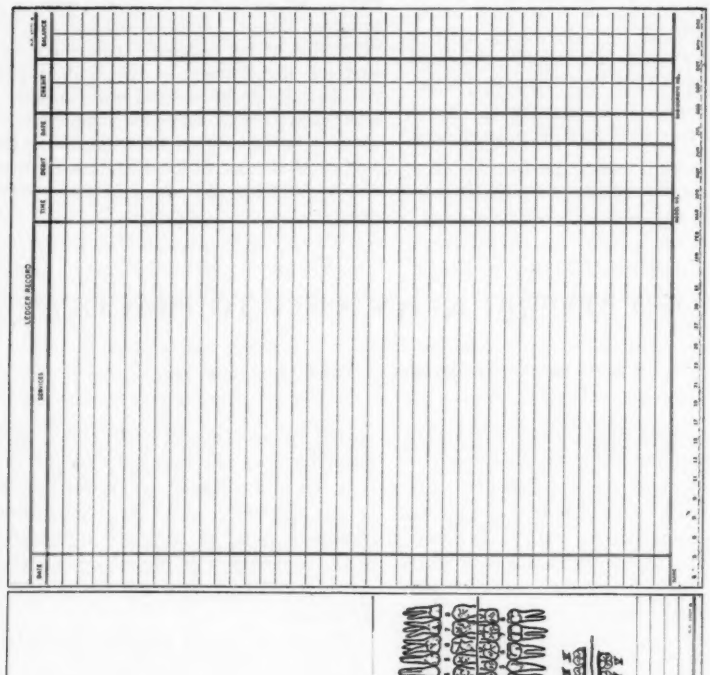


Fig. 1.—Service chart, front and back.

them with casts, photographs or the like. Whatever the desire, it is essential that the records be properly correlated in order to bring out their full possibilities.

Record keeping is not a recent discovery. It has been going on, perhaps crudely, for many years. In fact, it was record keeping that brought our profession into being. As men began to record their experiences and relate them to one another, our profession was born.

With its maturity, there has also come the expectancy of greater service, a service that will not only recognize a definite place of prevention in our daily program of repair, but also anticipate a closer affiliation with general health problems. Our observation, therefore, must of necessity be much keener and our dependence on records will logically become greater. Records are the foundation upon which we build the security of our profession.

It is gratifying to note that the Curriculum Survey Committee of the American Association of Dental Schools has seen fit to incorporate in its proposed curriculum a course in practice management. This has long been a neglected phase of dental education and its inclusion indicates the farsightedness of the Committee. In introducing the subject, it states:

> Practice management, as the name indicates, is a study of the management of a dental practice, with particular reference to (a) the relations of the dentist to his patients, (b) the relations of the dentist to other dentists and to physicians, (c) the keeping of adequate service and financial records and (d) the financing of the dentists' services and his living. . . .
>
> A system of financial and service records, based upon the principles of the course of instruction, should be adopted by the dental schools and the student should be taught how to make and use the records. The records should be of such type that the fundamentals can be used by the student in the financial and service record system in his practice, after he has graduated.

This is indeed a step forward. It indicates that the dental student of the future will be given instruction as to how to conduct his practice and how to keep records. It is hoped that the instruction will be broad enough to lend encouragement to the keeping of records in such a way that all the valuable information that will be recorded will be readily available; for unless some plan for indexing is suggested, the information will remain buried in the files, while human suffering continues. On the other hand, if, through proper indexing, it is brought to light, encouragement will be given to further study and earnest effort on the part of the operator, and he will be able to do his bit to advance our science and promote our care for human needs.

METHODS OF KEEPING RECORDS

Bound Volumes.—Records are kept in various ways. Probably the oldest method is that of using bound volumes. By this, we mean book forms. Probably, our appointment book is the best example. This form serves best where definite space can be allotted far in advance, such as the hour arrangements extending over a definite number of days, months or years. It is obvious that this form does not permit ready expansion or easy additions.

Loose-Leaf System.—The loose-leaf system offers many possibilities, such as ready expansion and insertion, that the bound volume does not. Generally speaking, this system precludes the use of a binder into which the sheets are placed, some having a locking device, which, when locked, really makes a bound volume out of a binder.

Filing Systems.—Probably the most popular system of record keeping is that

Fig. 2.—History and diagnosis chart, front and back.

of filing, alphabetically or numerically.

Usually, this is done by what is termed "vertical filing"; that is to say, the record sheets are filed so that they stand on end or side, supported by guides, with initials, name or number. The material may be filed loosely or may be inserted in envelops. The obvious objection to this type of filing is that the records must be added to frequently and the inconvenience and time consumed in execution must be thought of. Various methods are used to label such records, the most desirable being the use of the visible tab, which is attached to the guides or envelops.

Methods of horizontal filing have also been brought out. Probably the best known of these is the kardex system, which uses loose charts or sheets inserted in pockets and so arranged that the name on each card is readily visible when a tray is drawn out of the file. This system offers many possibilities and saves much time in execution because it is not necessary to remove the card for addition to the record.

Miscellaneous Files.—Box files have been found desirable to bring together financial records for the year, the year's correspondence, etc. The size depends on the amount of material to be placed in them. They are really a form of loose-leaf vertical file, arranged to bring together, in a compact way, material related to a complete unit.

CLASSIFICATION OF RECORDS

Let us now consider how to apply the principles outlined in the practice of dentistry. For the sake of convenience, let us classify our records into four groups: 1. Those having to do with the patient. 2. Those dealing with office routine and practice management. 3. Personal records. 4. Miscellaneous records.

Each of these groups will be found to be important and each should have a definite place in our practice. Let us consider each group separately.

1. *Records Having to Do with the Patient.*—Records having to do with the patient, might be spoken of as service, financial and miscellaneous. The service records would include the appointment book, examination, diagnosis, prognosis and service charts, casts, photographs, roentgenograms and graphs.

Appointment book: For recording the appointments, no better method has been found than using an appointment book; that is, a bound volume form.

The appointment book should primarily record the appointment. For this purpose, it should have an arrangement for months, days of the month and hours of each day. Appointments should be made by definite assignments of time. Keeping appointments is the first step toward a successful practice. Sufficient time should be allowed to render a definite service for the patient each time.

The tendency on the part of many busy operators is to make short appointments. While this may be desirable and necessary at times, it should be kept in mind that more can be accomplished in one one-half hour appointment than in three fifteen-minute appointments.

When a definite service is planned at a subsequent appointment, it has been found desirable to make a record of such plans when the appointment is made, so that such services can be definitely arranged for prior to the patient's arrival. It is also our custom, when the patient is dismissed, to record beside the appointment the service that has been rendered. Obviously, this necessitates use of a larger appointment book than is ordinarily used. I have found the "Standard Diary" to meet this need. This comes in various sizes and the time schedule can be arranged to meet one's own requirements.

The appointment book should, there-

fore, list the activities of the day, and in order to make these activities as rhythmic and pleasant as possible, accuracy must prevail and promptness must be the watchword.

Examination, history charts, etc.: of this system; the size is 5 by 8 inches, although the history chart (10 by 8) must be folded to reduce it to this size, but it is so folded as to make the whole record visible with little effort.

Examination, history and diagnosis

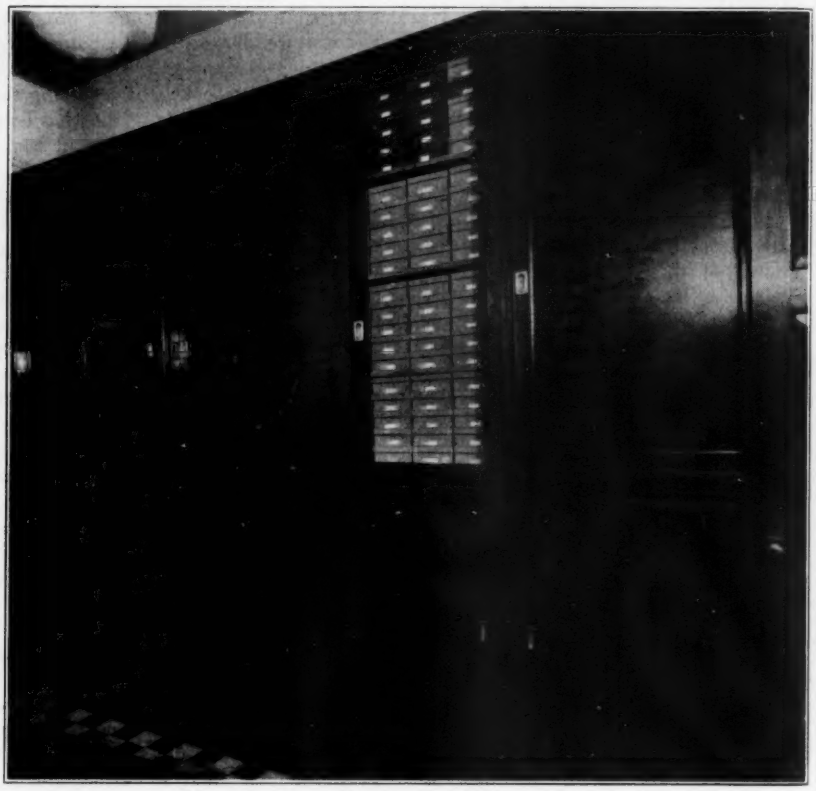


Fig. 3.—Cabinet built to house plaster casts, which are placed in boxes, properly numbered and stored numerically. Careful workmanship and attractive finish make such a cabinet quite acceptable in an office.

Examination, history, diagnosis, prognosis and treatment charts have all been found to be best handled in a loose-leaf form. Since the kardex system is the one used, the charts are all made to fit the pockets charts may be combined in one. This becomes a matter of individual preference, as well as logic, according to procedures in the conduct of practice. In some practices, it is a distinct advantage to have an

examination blank on which to record the condition found, possibly take an impression for study and arrange to see the patient subsequently for further examination, discussion of treatment and prognosis. This is particularly true in the practice of orthodontia, and it would seem that it could be applied with success and satisfaction in the field of periodontia, except when an emergency dictates immediate service.

The mere recording of cavities or missing teeth is not sufficient in the true sense of dental health service. A thorough examination of all the tissues in, and associated with, the oral cavity is equally essential.

Checking oral conditions as we find them today with the conditions of the same tissues three, six, twelve or more months previously will bring to light many important and interesting developments and may point the way to a preventive service, which otherwise would be entirely overlooked.

Fig. 4.—Corner of record room; showing vertical file and kardex arrangement.

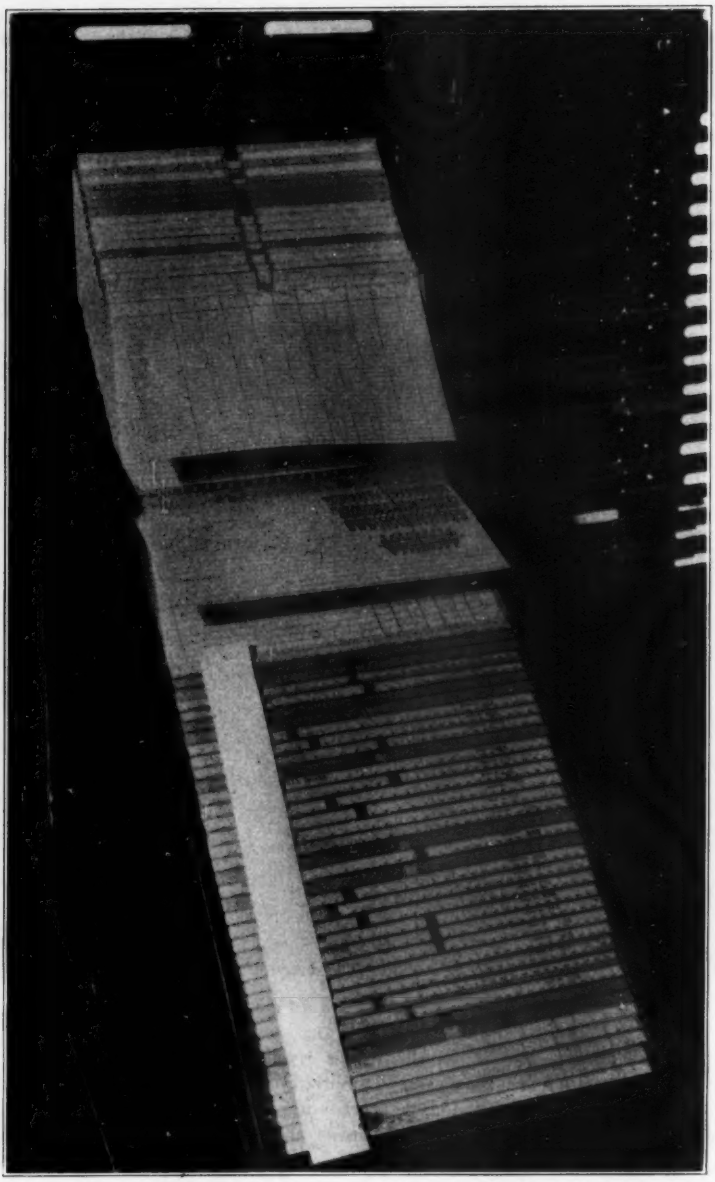


Fig. 5.—Close-up view of tray showing arrangement and accessibility of records.

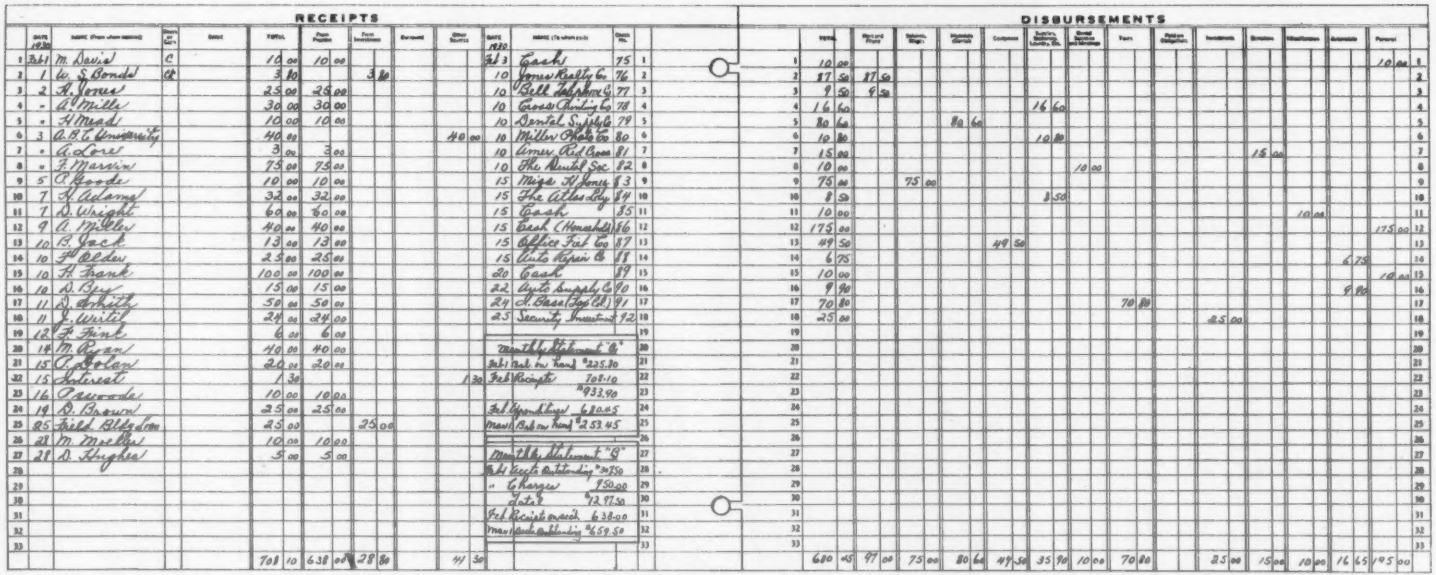


Fig. 6.—Method of recording receipts and disbursements to make government income tax returns easy and accurate. Monthly statements are included.

1927

A chart, then, that will enable us to make a number of subsequent records of findings has advantages that should appeal to any one attempting to render a real service.

With this in mind, and at the request of a number of men in general practice, charts (Figs. 1-2) were made up to be used in the kardex system. Figure 1 shows the front and back of what might be termed the service chart. Figure 2 shows the history and diagnosis chart.

While the latter chart may not include everything that one might wish, I believe it to be fairly complete. The various possible conditions of the different tissues are listed, and if an effort is made to go over the chart thoroughly at the time of each examination, a complete survey will result. If, then, the examination records some conditions materially different from the previous one, it is a signal that calls for a thorough and immediate consideration as to the cause. Such services impress the patient with our sincere interest in their well-being, and such records become valuable assets to practice. One can easily understand that they can become the means of holding patients.

Fig. 7.—Overhead cabinet built in for storage purposes. This utilizes space to the greatest advantage and, when the cabinet is neatly made and placed, is not objectionable.

It would seem that such a plan should have a very favorable appeal to those interested in periodontology, and it is urged that serious thought be given the matter.

Whether examination, history and diagnosis charts are used separately or in combination, somewhere space should be

provided for the recording of discussions as to plans of treatment, advice, cost, etc. It is foolish to attempt to remember these things. It is impossible, if one were to try. A few notes made at the time will save many hours of worry and give one a margin of confidence and a sense of security that pays dividends as practice increases. It is assumed, of course, that the records are so filed as to make them available at all times at a moment's notice. Too much cannot be said for the kardex system of filing as regards availability of records.

Plaster casts: As stated before, plaster records are of inestimable value in the practice of dentistry. It is to be regretted that they are not more generally used. The orthodontist seems to be alone in the use of this adjunct to other means of record keeping. Would periodically made casts not tell many things to the periodontist? Would they not help one to render better service to all patients by showing more clearly the changes that take place from time to time? Would it not be of great value to have casts of mouths made before denture service is even thought of? If this idea could be entrenched in the minds of patients, would not that help one to hold them?

Casts should be filed in a definite way. Boxes of proper size, with the case number of the casts on them, visibly placed, have been found to be best. A number of casts can be placed in each box. The number of an individual cast should, of course, be recorded on the history or examination chart for easy reference. Wall cabinets can be made to house these boxes, so that their storage need not be objectionable. (Fig. 3.)

Photographs, roentgenograms and graphs: Photographs have a definite place in a complete record system. They record conditions that would otherwise go unrecorded. Yet, a photographic record, to be of greatest value, should have uniformity of size. The more nearly it can be standardized, the better.

The use of the roentgen rays is becoming more and more general and a roentgenographic record of oral conditions will soon be the rule rather than the exception. Experience has demonstrated the importance of these records. It has also demonstrated the need for a systematic method of mounting, labeling and filing, so that the roentgenograms are ready for reference and use at all times.

If graphs, charts or outlines are used in making the diagnosis or planning the treatment, they too should be given the needed attention for proper filing.

All of these—photographs, roentgenograms or graphs—are best filed in envelops of sufficient size in an upright position. Identification is best made by number and filing done numerically. The history or examination chart carries the number of the particular case and makes for easy reference to the numbered envelop when necessary.

Financial records: The second group of records that have to do with the patient are the financial records. Usually, the card or sheet that records the services rendered also has a space aranged for recording the charges that are entered for that service. In the loose-leaf or card system, this same card or sheet also has a column for the credits that are entered when payments are made. Formerly, the payments on accounts were listed each day in the appointment book on the date of receipt, but I found it advisable to use a separate book (a "Standard Diary" of smaller size), wherein the receipts for each day are listed, and at regular times posting in the individual ledger chart.

In the kardex system, these cards are arranged so as to make the whole transaction visible when the pocket immediately above is raised. Its greatest advantage

comes in the use of color signals to call attention to appointments, payments, etc. The signals are visible even when the pockets are down and therefore flash the information at a glance. (Figs. 4-5.)

Figure 4 shows an arrangement of vertical and kardex files. The vertical files are used for filing correspondence, photographs, roentgenograms, etc. The kardex file carries the other records. It is shown here in what is known as the kardex safe, which protects the records when the safe is closed as shown in the section to the left. The center section shows two trays drawn out, the tray to the right showing how the pockets are lifted to expose the complete records of the case.

Figure 5 is a close-up of one of the trays, demonstrating visibility and accessibility of records.

Miscellaneous records: Another type of record keeping having to do with the patient is correspondence. Correspondence is necessary in many cases, but its significance is lost unless it is filed systematically.

Vertical files, preferably alphabetically arranged, will take care of this need excellently. Notation on the history or examination chart will readily designate where the correspondence is to be found. The notation should include the date of the correspondence, so that if, several years later, reference must be made to it, it can readily be found. Experience has taught us to file all the correspondence for the year in a letter-box file, distributing it here alphabetically. A label on the outside of the box-file reading, for instance, "Correspondence, 1932" will make it easily available. It has been found desirable to make a duplicate copy of all letters written. The duplicates and the incoming correspondence are filed separately, alphabetically.

2. *Records Dealing with Office Routine and Practice Management.*—Such records should include receipts and disbursements, monthly and yearly statements, bills paid and bills receivable, correspondence, inventories and miscellaneous records and an indexing system that will put the recorded facts at one's finger tips.

Receipt and disbursement records: It is not enough that the amount paid on account is placed on the patient's record card: something should also be known about total receipts from payments. There should also be a record of expenditures connected with the conduct of practice. One's income must be determined by ascertaining the excess of receipts over disbursements.

Accurate records of these things should be kept not only for the dentist's own benefit, but also to meet the demands of the government in respect to income tax. The government has seen fit to place receipts and expenditures under specific headings and it facilitates making out tax returns if the items can be placed under such headings in monthly records. A form of loose-leaf, properly arranged by columns and headings, makes such record keeping a relatively simple thing. (Fig. 6.)

Receipts are listed under several headings, such as "From Practice," "Investment" and "Other Sources," while disbursements are carried under headings such as "Rent, Phone," "Salary, Wages," "Materials," "Printing, Laundry," "Dental Meetings," "Taxes," "Donations" and "Obligations." A total column for all receipts or all expenditures precedes each of these receipt or disbursement groups and from them the items are distributed to the proper columns. Such distribution enables one, through vertical and horizontal totals, to prove the accuracy of one's figures.

Statements: From the foregoing, it is

a relatively easy matter to make a statement on the first of each month, giving the following information:

Jan. 1, 1934—Balance on hand and in bank,	$xxxxx.xx
Receipts for January, 1934	xxxx.xx
Total,	$xxxxx.xx
Disbursements, January 1934,	xxxx.xx
Balance on hand and in bank, Feb. 1, 1934,	$xxxxx.xx

Another statement that should be made up each month is this:

Jan. 1, 1934—Accounts receivable,	$xxxxx.xx
January, 1934, charges,	xxxx.xx
Total,	$xxxxx.xx
January, 1934, receipts,	xxxx.xx
Accounts receivable, Feb. 1, 1934,	$xxxxx.xx

Both of the foregoing statements are made up so that we can see just how our practice is growing or diminishing and whether receipts are keeping pace with charges; all of which it is desirable to know when budgeting expenditures.

Statements for patients: Statements of services rendered should be made out and mailed to patients on the first of each month. If full settlement has not been made, strict attention to this will collect many accounts.

Bills payable and bills paid: A systematic method of filing bills payable and bills paid is important. Usually, they are filed loosely between vertical guides, properly labeled, the "bills paid" being further distributed under proper monthly headings. At the end of the year, they are placed alphabetically in a box file labeled "Paid Bills," with the year added.

Correspondence relating to matters of practice: Correspondence relating to matters of practice is filed in the same manner and disposed of at the end of the year. After years of practice, storage of such records becomes a problem, but the use of neatly built overhead cabinets has been the solution. (Fig. 7.)

Inventory and miscellaneous: It is, I believe, of importance to take regularly an inventory of office equipment and supplies. This procedure will bring many things to light and serve many useful purposes throughout the year.

It is impossible to describe here all the minor records that are and should be kept in conjunction with practice management. Check-book stubs, canceled checks, bank books, deposit slips, all are important and need close attention if we would know at all times where we stand.

Indexing: There is one more method of recording that needs to be mentioned here. It is one that is seldom employed, and yet it means so much to the professional man that it should not be overlooked, and that is the indexing of records. I refer particularly to the information gathered in the examination, history and treatment charts.

Indexing is nothing more than a plan to place the information at one's finger tips. Let us for the moment assume that we have a complete record of 1,000 cases. For one reason or another, our interest becomes centered on a particular etiologic factor, or we wish to check up on the treatment of a particular condition. It would be hopeless to try to check through the 1,000 cases to get the information. If, on the other hand, the cases or conditions have been properly recorded and classified by number or otherwise, on a card properly labeled, at the time when the patient was cared for, it will be a simple matter to check over cases as listed on the card under that particular heading. An index will do just that.

Not only does preparation of articles become much easier through the index,

but also, from a practical angle, much is gained from a review of the experiences in treatment of groups of cases. As a result, such methods become a valuable asset in any practice.

3. *Personal Records.*—Personal records can also be readily included in the office routine. In fact, generally, they are so closely interwoven with practice records that they become a separate division here only for convenience in discussion. They include obligations of various kinds. Regularly recurring personal obligations should be recorded to avoid forgetting them. Investments should be recorded showing payments, earnings, etc. Dates that insurance premiums are due should be registered so as to bring them to attention. Budgets, family obligations, automobile expenses, all of these and more can be arranged readily, if a fair amount of thought is given to them.

4. *Miscellaneous Records.*—Miscellaneous records might include those of other business connections. It is always a good plan to keep business records as far from the practice records as possible. As a rule, the two do not "get along" side by side. One or the other usually suffers. But if such a condition exists, records should be kept.

CONCLUSION

1. Records are necessary if we wish to serve our patients in the best possible way.
2. They are necessary if we would help to advance our profession.
3. They are necessary if we wish to advance ourselves.
4. Properly kept, records will be an asset and not a liability to practice.

BIOLOGIC FACTORS IN DENTAL DISORDERS*

By SAMUEL RABKIN, D.D.S., Cincinnati, Ohio

DURING the past few years, renewed effort has been made to determine the factors in the degenerative changes in the dental structure. This embraces every type of dental disease, such as caries, hypoplasia of the enamel, metabolic dysfunction and catabolic influences involving the teeth and their investing tissues. In reviewing the recent literature on dental disorders, we find that investigators, in most instances, are of the opinion that dietary and nutritional disorders, or some local conditions, such as salivary fermentation, are responsible for the breakdown of the dental structures. As in any other scientific investigation, we find some divergence of opinion, but, on the whole, the main issue is the diet and its influence on the jaws and teeth.

Much good has been accomplished by certain investigators; but more remains to be done before clinical findings approximate obvious reality. The paramount importance and seriousness of dental problems are made apparent from the various reports, which conclude that about 95 per cent of the children of the United States have carious teeth, and

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-Seventh Annual Session of the American Dental Association, New Orleans, La., Nov. 5, 1935.

that alveoloclasia is frequently manifest in early middle life.

Regretfully, it may be said that our more reliable sources of information are not always discreet in their statements regarding "how to build good teeth and keep them," or how to eliminate caries and cure pyorrhea; and how to do many things over which the clinician ponders. In the wake of these investigations, there also follows the enthusiatic but less informed element—overzealous health promoters, theoretical speculators, dispensers of special brands of foods and drugs, special dietitians and commercial agencies. It is obvious that interference with such an important study cannot but result in false conclusions on the part of the uninitiated student and the public. The effect of loose statements on the mind of the layman is evidenced by the despairing and common request of the patient for some special diet, the kind of vitamins or calciums that will stop the ravages of tooth decay, or for drugs having the power to reattach gums to loose teeth. From the standpoint of the clinician, these and many other similar statements brought to our attention do not offer any basis for rational discussion, and they are presented only as an illustration of the prevalent misguided concepts of the subject and the type of material which has saturated our recent literature. In entering this discussion in dental pathology, it is not with any intention of raising a controversial issue, and not to disparage any hypothesis if based upon clinical observations.

It is essential that we reconsider primarily the common belief that dental disease is entirely the product of advanced civilization. There can be no doubt that the material aspect of our present civilization is in a great measure responsible for many health problems, among which those concerning the teeth are to be included. While I may be presumptuous in the assertion that the teeth are least resistant and least tolerant to insult and organic changes, it is quite apparent that, in the process of evolution from lower species to man, Nature could not evolve a more specialized organ in the constitution than the teeth.

EVOLUTIONARY CHANGES OF THE HUMAN DENTITION

To trace the origin of the degenerative changes affecting the masticating apparatus, it is necessary to review the history of the evolution of the human dentition. From all available evidence, it is definitely established that the human tooth did not evolve in accordance with an intended design or pattern. It is therefore important that we consider the corollary features and the relative structural transformations of the teeth in the human predecessors, from the jawless Chordates of the Silurian period to recent man.

Briefly, let us consider the impelling need and the acquisition of teeth by the lowest orders of animal life, involving numerous structural stages and variations. After these transitory changes, originating with the jawless and toothless Chordates and extending to the most complex dental arrangement in the primitive vertebrates, reptiles and mammals, there was a reversion to a simple dental formula in man. According to reliable estimates, the time required for the evolutionary physical changes from fish to man was from 500,000,000 to 600,000,000 years. During all that time, the evolutionary changes in animal life were constant and continuous. Every period brought forth newer varieties of living creatures, distinctly different from the original species in physical structures and habits. In most instances, the physical changes were inevitable, being accomplished either through the process of elimination of the

weaker creatures through the ever-increasing size and strength of their successors, or the physical unfitness of the earlier forms of life to perpetuate their own species. Adaptation to environmental changes, modification of coexistent fauna and the struggle for existence created a constant demand on the creature to evolve organs of the body to serve as weapons of offense or of defense, or for crushing the

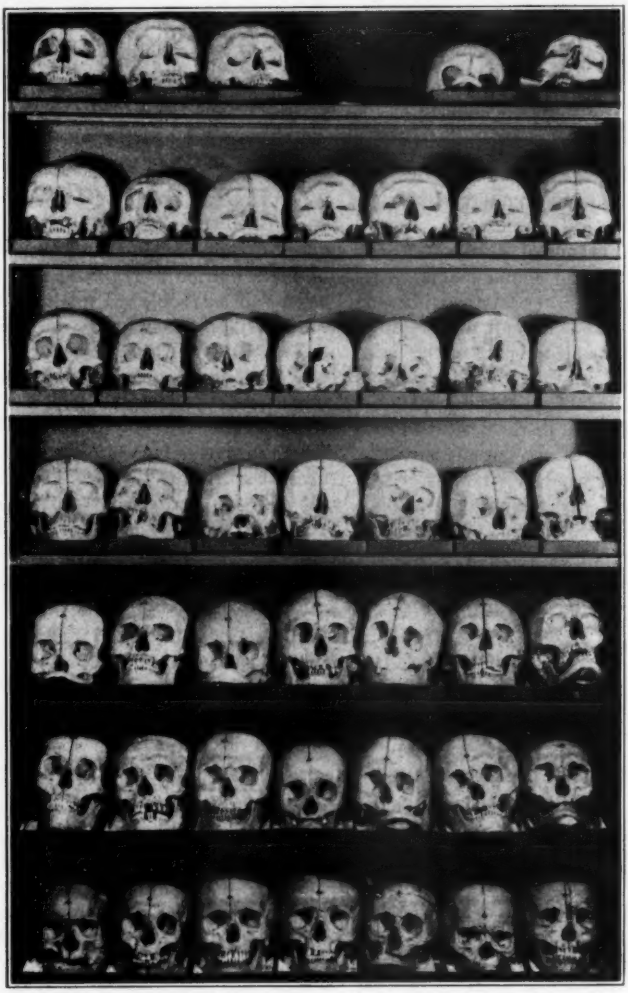


Fig. 1.—Craniums of contemporary man, mute evidence of declining dentition. (From Hammann Museum, Cleveland, Ohio; courtesy of T. Wingate Todd.)

body of the prey before devouring it. It was coincidental with the adaptation of other organs of specialization, such as teeth. The acquisition of teeth as one means of survival obviously subjected the animal to various transitory changes in ac-

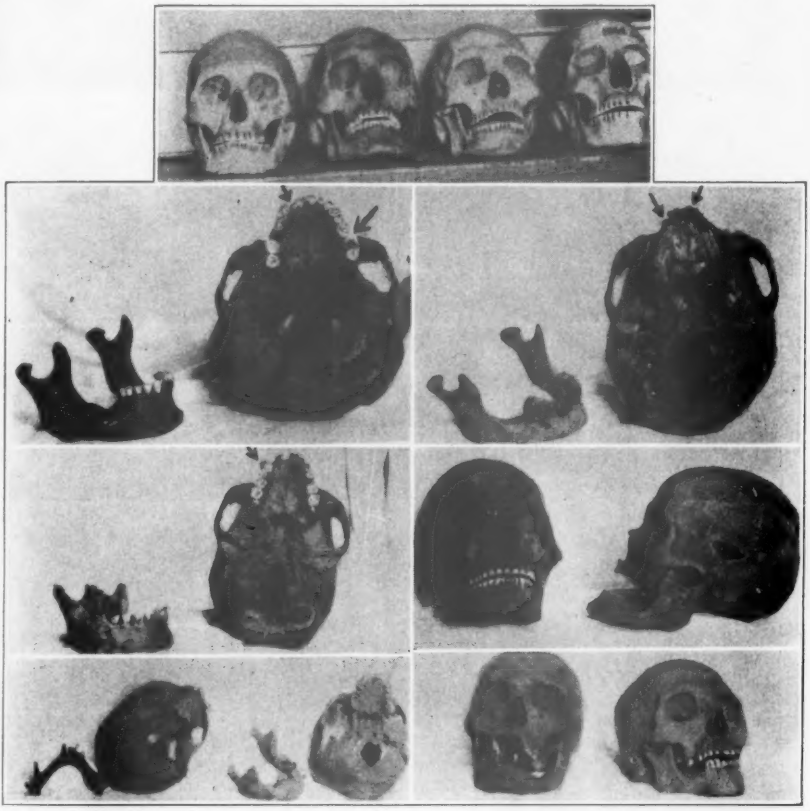


Fig. 2.—Skulls and jaw bones of early Kentucky, Dakota and Illinois Indians. There is a natural predisposition or immunity to dental disorders in these prehistoric people of a single origin, living at approximately the same period in a similar environment. Above, left: Typical Mongolian skulls with large jaws and teeth, with perfect dental arrangement, from subjects that had reached or passed middle life with almost total freedom from dental disease. The condition of these skulls is in contrast to the pathologic manifestations in the remaining specimens. Unquestionably, premature loss of teeth is indicated in the edentulous skulls. (From the Smithsonian Institute and the Donald Dickson collection.)

limbs, claws, horns, body protective armor and wings, that there arose, in the process of natural selection, the need for cordance with body proportions and the requirements of the species. Thus, we find that with the evolution of the various

Fig. 3.—Structural variations of skull, invariably associated with dental conditions. The three photographs above show skulls of Egyptians of the Twelfth Dynasty (about 4000 B. C.), presumably a pure race. Notwithstanding the homogeneity, environment and food habits, there is a diversified structural architecture, with corresponding dental irregularities. The two photographs in the center show skulls of Egyptians of the early Christian period. The tendency to dental irregularities is more pronounced than in the skulls shown above. The four photographs below show skulls of Egyptians of the Twelfth Dynasty. The skulls at the left show premature loss of the teeth, with complete atrophy of the alveolar process and a large opening in the left antrum. Those at the right contrast the normal with extreme abnormal conditions.

species and their physical adaptations, there were modifications in the architecture of the dental apparatus. The shape, size and distinct structure of every variety of teeth evolved in response and in conformity to the environmental needs of the animal as to food, means of combat, mechanics or self-preservation. Any change of circumstances produced new wants, which necessarily created new habits, thereby requiring a change in dental equipment or arrangement. The constant use of the teeth, or the cessation of their use, was the governing factor either in the constant development of dental reinforcement or in its decline.

Not only did the anatomic structure of the teeth alter simultaneously with other evolutionary changes of the body, but also the investing tissues or alveolar process underwent proportionate and reciprocating adaptation. Compensating accommodations for root retention evolved in accordance with the type of tooth and its functions regardless of its length or the respective number of roots. Much depended on the size of the species and the tearing and crushing strength of the dental mechanism, as well as the location of the teeth.

Masticating power was an essential factor in the development of the chewing and grinding teeth. While it was necessary for the flesh-eating animals to evolve front teeth, with which they could easily catch their prey and pierce its tough hide, cut through the muscles and crack its bones, of equal importance was the use of auxiliary teeth for chewing purposes. Cusps or ridges in the cheek teeth, which would grind the food, were the prerequisites for the preparation of food for digestion. Such grinding of food naturally depended on the respective type of species, and the form and pattern of the grinding teeth differed in as many respects as the species themselves. It was quite natural for the slow herbivorous chewer to adopt a masticating mechanism divergent from that of the carnivorous or the smaller arboreal animals and the rodents. In many instances, this probably resulted in a change in the dental structures incompatible with the life and habits of certain species and favorable to the progressive development of others. This tendency is evidenced in the major contrasting extremes of the huge tusked animals and the edentates. It is perhaps during these stages of diametrically opposite transformations of the dental structures that there were signs of dental disease, excluding of course accidental injuries to the teeth and jaws.

ORIGIN OF DEGENERATIVE CHANGES

For millions of years, the functioning of these animals for successive generations in whatever new environment circumstances forced them underwent either progressive or retrogressive adaptive modification. The teeth, being of a highly specialized nature, yielded, for want of use and injury, to degenerative changes, which existed among the earliest forms of prehistoric living creatures. Moodie cites instances of tooth degeneration in prehistoric animals, but instances of actual caries are rather limited, references including traumatic and anomalous conditions as well. Alveolar involvement is more frequently to be observed in almost all types of prehistoric animals, either localized or involving most of the alveolar process. The effect of such degenerative changes was most damaging to the dentition of mammals and man in the higher stages where the dentition consisted only of eruption and loss of the deciduous and permanent set of teeth instead of the phenomenal process of continuous tooth growth and replacement, which prevailed in archaic reptiles and still prevails in certain mammals and

rodents. Owing to the delicate and peculiar anatomic structure of the nonsuccedaneous tooth, it is less resistant to

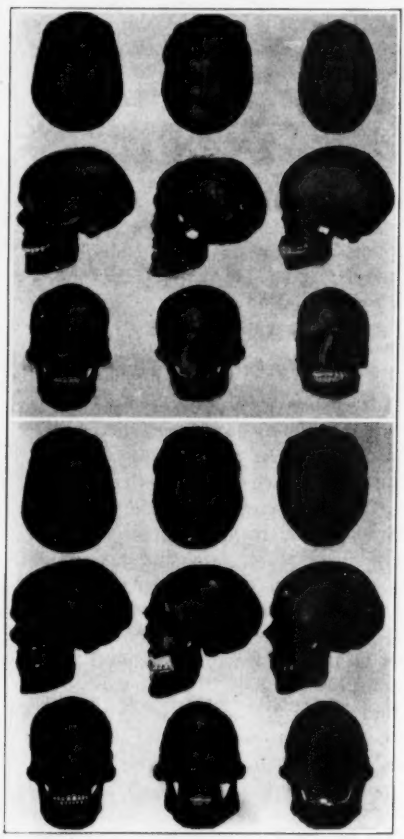


Fig. 4.—Anthropometric and anatomic variations in early man. Above: Two craniums (left and center) of Cro-Magnon compared with one (right) of Grimaldi negroid type. Below: Craniums of Cro-Magnon, Obercassel and Eskimo. (From the American Museum of Natural History.)

insult and readily succumbs to injury. Thus, we find evidence of dental disease among prehistoric mammals, the Neanderthal man and the Cro-Magnon of southwestern Europe, the early man of South Africa (Man of Kenya [Leaky]) and all other primitive people that followed. This condition also prevails in the recent anthropoid family. Though I had no access to the original specimens of the teeth of the Pithecanthropus Erectus, photographs as well as cast reproductions strongly point to an interproximal cavity in one of the molars. With the exception of the Rhodesian skull, where disease of most of the teeth and jaws prevailed, alveoloclasia was extensive in the jaws of the Neanderthal, Cro-Magnon and other prehistoric human beings of approximating periods. Among more recent man (the Egyptians, early American Indians, South Americans, Mongolians and early mongoloids), we find dental disorders of various kinds, often simulating the type of dental disease common in man today. This statement must not be construed to mean that dental disorders in prehistoric and primitive man were so prevalent or so extensive as they are in modern man.

CAUSES FOR THE DECLINE OF THE HUMAN DENTITION

Civilization and refined social habits, especially faulty food habits, correspondingly lessened the functions of the teeth. Alteration and progressive decline of the human dentition were followed by the inroads of socio-economic conditions. Between the dental conditions of prehistoric or primitive man and man of today, there can be no analogy; but even the man of antiquity had his share of dental troubles. With the advance of progressive civilization, it became evident that the teeth suffered from limited usage, or disuse atrophy, as the result of a sedentary life, environmental changes, frequent mixed matings, with subsequent hybridization, etc. These conditions resulted in struc-

tural aberrations, which were varied and mixed, with often a complete departure from the original cephalic index. Degenerative changes of the dental apparatus were followed by undernourishment caused by a lack of wholesome food and functional irregularities of some of the cephalics and brachycephalics were to retain the respective identities of their strain altered by environmental changes and food habits. Such evidence of relative immunity is sometimes noted among certain remote and semicivilized tribes, especially the Mongolians, Eskimos and

Fig. 5.—Earliest known evidence of dental disorders. Left: Abscess cavities and atrophy of jaws due to premature loss of teeth. Right: Alveolar involvement of suppurative type. (From the Smithsonian Institute; LaChapelle and LaFerrassie skulls, Neanderthal.)

internal secretory glands, and many other remote conditions.

The contention of Rose and others that the long-headed individual may be susceptible or the short and round-headed individual may be immune to dental diseases could be valid only if such dolichomesocephalic mongoloids, whose sturdy jaws and teeth are in better health than those of the urban dweller. As an illustration, we may also consider the prehistoric long-headed Egyptian and the African Negro, who were relatively free from dental disease as long as their physical character-

istics were not modified by environmental conditions.

A distinct structural uniformity, which is rare, but which may be regarded as characteristic of one or another type of people, is an indication of isolation and association with primitive customs of living and food habits. Generally, we find that the tendency to anatomic structural

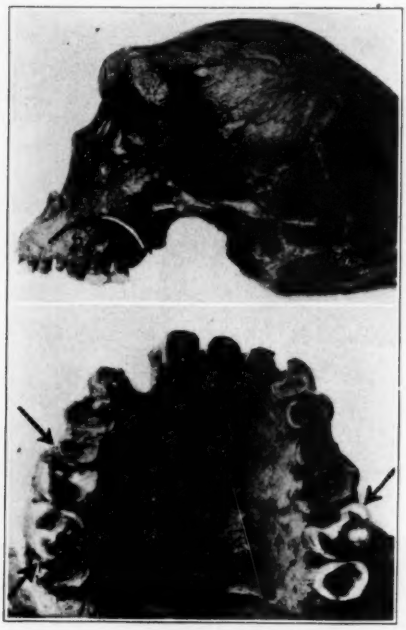


Fig. 6.—Rhodesian skull; earliest known evidence of dental disease in human being. Root abscesses have perforated the alveolar wall. There is extreme attrition of the anterior teeth with partially abraded posterior teeth and obvious dental caries. (From the American Museum of Natural History.)

variations prevailed among the early human prototypes, such as the South Africans, Cro-Magnon and their successors. This phenomenon was further altered by racial diffusion and territorial expansion. Migrating expeditions leading to association with neighboring tribes, invasion and constant warfare were potential factors in racial amalgamation. These factors are significant in the study of anthropometric and anthropologic variations as related to the predisposition or immunity to dental disorders. Briefly, it may be stated that the natural physical endowment of the original stock or the acquired variations of long standing will continue until the advent of some radical body alteration as a result of extraneous conditions. On the other hand, the observations of those who attribute susceptibility to dental caries to certain individuals are, to some extent, borne out by clinical experience. These conditions may not be ascribed to dolichocephalism, but to the gradual tendency toward constriction of the dental arches; crowding and overlapping of the teeth; lack of space and of opportunity for self-cleansing, and the formation of areas retaining food débris. The sturdy jaws of the brachycephalic, with perfect rounded arches and well-developed teeth, are unquestionably the most striking examples of an ideal dental arrangement, which should normally be man's heritage. At the first glance, it is apparent that the latter type is representative of the early human dentition, and therefore the dental structure should be less susceptible to dental disease. The tendency to caries in this type is not so common as among those having a constricted arch, but the teeth in contemporary man are equally subject to decalcification and alveoloclasia.

One of the most common abnormalities, which is no more prevalent today than it was thousands of years ago, is the breakdown of the investing tissues. This cellular disintegration of the alveolar process, whether atrophic or pyorrheic, is a phenomenon transmitted to us as an inheritance from our ancestors of the stone age. This condition is sometimes re-

garded as a sign of senility and looked on as a nonpathologic condition that has spared neither type nor race, including prehistoric and recent animals. No doubt, it is a natural sequence when one passes middle life. At this stage, life begins to

Fig. 7.—Evolution of human mandible. Top to bottom: Mandible of chimpanzee, Piltdown man; Heidelberg man; Neanderthal man, and recent man. (From the Smithsonian Institute.)

reverse itself. The cycle of cellular reproduction is usually on the decline with the advance of age, and, for the most part, there is a tendency to loss of lime salts from the bones, which become brittle, atrophic degenerative changes often following.

This condition is particularly aggravated when the alveolar process is involved. Unlike the rest of the skeleton, which is protected by adherent soft tissue, the alveolar process is subjected to continuous injury from the forcing of food between the loosely attached gums and from the activity of the ever-present bacteria of the mouth. Of the two main classes of alveolar involvement, i.e., atrophic and pyorrheic, the latter tends to be congenital, is definitely more pathologic because of diffuse cellular disintegration and is, phenomenally, transmitted by inheritance.

The foregoing may clarify some of the perplexing questions on alveoloclasia and pyorrhea, not only with a view to correcting defects by specific treatment, but also to account for the usual causes. Some consideration must be given to the unknown cause of the tendency to transmit this condition to progeny, no matter on which parental side the predisposition exists.

HEREDITARY CHARACTERISTICS

Heredity is a perpetuating link binding successive generations together. The physical benefit that one generation derives is in relative proportion and corresponds to the benefits acquired by the preceding generation. Clinically, we often observe that deviations and acquired variations are also transmissible. This tendency is apparent in the congenitally spaced central incisors, rotated or peg-shaped lateral incisors and notched or missing teeth. Newly acquired characteristics are not governed by a definite span of time, but are the direct results of internal and external conditions.

To the dentist, the appreciation of

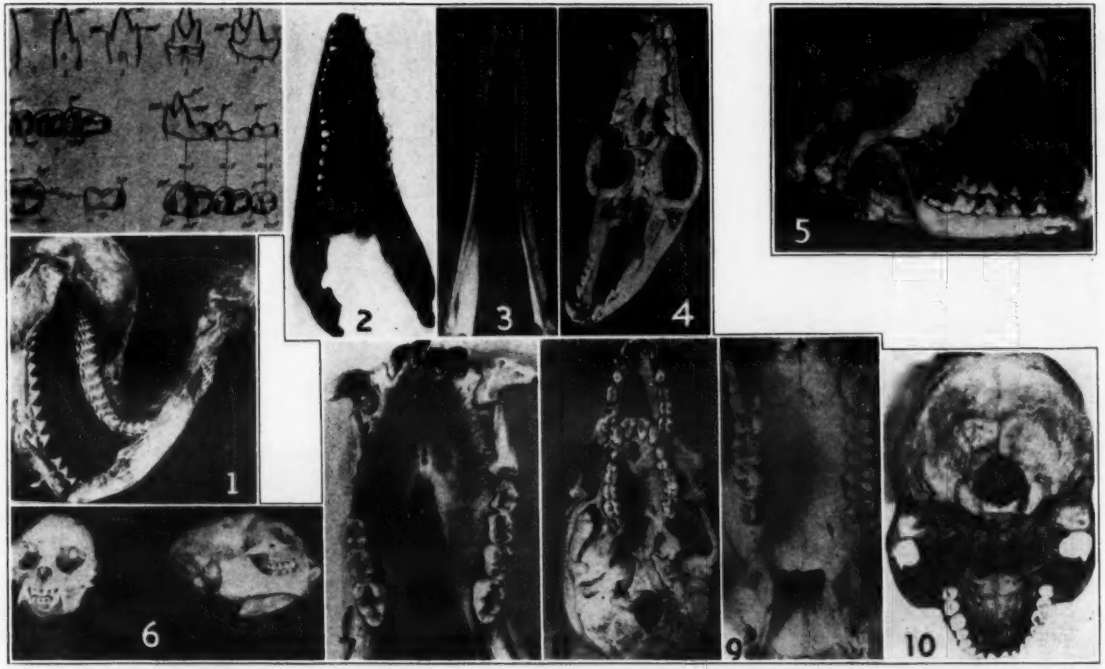


Fig. 8.—Evolution of cusped teeth from fish to man. Above, left: Cope-Osborn concept of development of cusped teeth. *1* to *10*, evolution from early fish and reptile cone tooth to tricone in early mammals to cusped posterior teeth in later mammals and man. *1*, blue shark; *2*, crocodile; *3*, dolphin; *4*, opossum; *5*, civet; *6*, marmoset; *7*, mandrill; *8*, macacus monkey; *9*, gorilla; *10*, man.

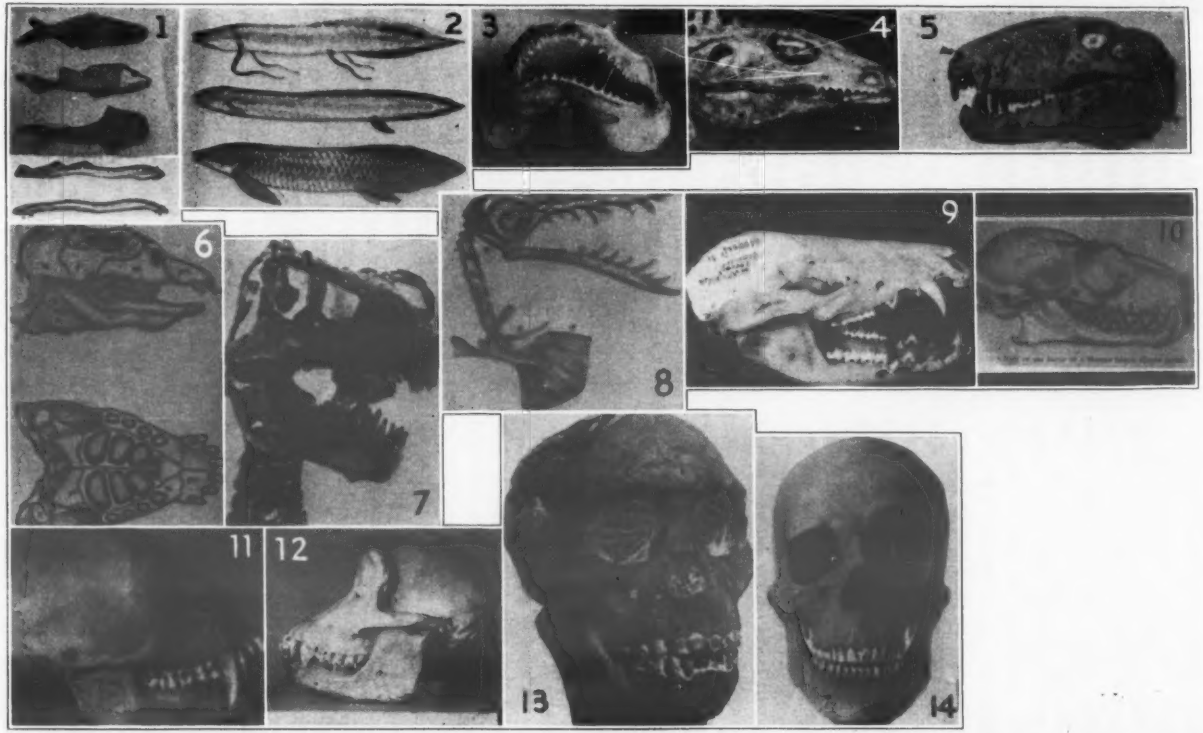


Fig. 9.—Transitory stages in evolution of dentition from fish to man : *1*, jawless and toothless chordates; *2*, lungfish; *3*, shark; *4*, eryops (amphibian); *5*, dimetrodon (long toothed reptile); *6*, placodus (pavement block teeth); *7*, tyrannosarus (dinosaur); *8*, rhamphorhynchus (toothed bird); *9*, opossum; *10*, lemur; *11*, baboon; *12*, chimpanzee; *13*, Australopithecus Africanus (Dart) (protohuman); *14*, recent man.

hereditary influences as transmitted from parent to progeny is an important factor in the diagnosis and treatment of dental disorders. Clinically, we observe certain morphologic aberrations or irregularities, with a tendency characteristic of either the paternal or the maternal side. Excluding accidental anomalies we find certain irregularities manifest in one child and absent in another child of the same parents, notwithstanding the environment and the type of food afforded in both instances. It is therefore unfair to assume, in this particular instance, that the disturbing element affecting only part of the family is nutritional. With respect to our endeavor to correct some of Nature's errors in the construction of the human dental mechanism, it is imperative that we concentrate on the structure or the cause for specific pathologic phenomena. The overpopularized terms "caries" and "pyorrhea" are often assumed as convenient phrases, with no special design to define prevailing clinical manifestations. In justice to the investigators engaged in the search for the causes of dental disease, it may be said that many advanced theories represent rational observations, provided the ascribed causes apply to a particular phase of degenerative change. Dental ailments as currently described do not submit to any classification, mechanical, chemical or traumatic. The abstract theories of the present trend appear as surprising, in view of the voluminous and ably presented contributions on the subject of dental pathology that have continually appeared in scientific treatment since the early part of the eighteenth century. Moreover, it would be equal to folly to snatch at the various panaceas outlined, each of which is regarded by its sponsor as a scientific cure for most disorders, irrespective of the underlying causes. The objection to such captious suggestions is that there can be no common cause or universal treatment of all dental ailments. Our latest attempts to restore the supposedly depleted lime salts from the teeth and jaws by gorging the patient with various synthetic compounds are based on another unproven hypothesis. Individuals differ in their biochemical complex as well as range of internal secretion. It is reliably stated that chemical variations are constantly occurring in various periods of life, with constitutional variations and in relation to organic and glandular conditions. While these facts are significant, evidence would be lacking to determine the chemical status of an individual from casual observation, or whether the deviations from the so-called normal may be due to a deficiency in lime salts, elements holding the cells together or in the internal and salivary secretions. The internal chemical reactions and their possible influence on the decalcifying tooth, referred to above, should be differentiated from the local disintegration of contacting parts of the surfaces of the enamel due to lack of hygienic care and acid fermentation.

CONCLUSION

Avoiding abstract and speculative formulas, let us consider impending prospects of progressive regeneration concomitant with degenerative changes. The struggle for existence faced by primitive man is no longer imperative for human survival. Predaciousness, accompanied by physical suffering, was, in prehistoric man and beast, a sheer necessity, when there were no other means to sustain life. Doubtless, many species of animal life have been exterminated in rival strife. Tribal warfare among savages, and later among civilized peoples, resulted in irreparable physical damage to the participants, definitely influencing the health conditions of their communal life. Aggressive competition, misunderstanding

and lack of proper adjustment to socio-economic life were at all times factors in the physical decline of the human race. Forced adaptation to seemingly inadaptable circumstances leads to conditions inimical to the normal function, and are potentially a cause for functional variations of the body. Correlation of organs within the body is essential to functional harmony. Modification of one organ involves other organs, and particularly the overspecialized tooth, which is the first to suffer.

In our attempt to overcome abnormalities, we must be cognizant that neither animals nor plants are synthetic combinations of organs and prescribed treatment must embrace more than palliatives for eventual benefit. It is obvious that the dental structures are suffering irreparable damage due to functional disuse of the masticating apparatus, inadequate provision of foods essential to health, disproportional consumption of substitutes and lack of accommodation to a rational mode of living.

SUMMARY

1. During the ages preceding man's existence, structural modifications of the masticating mechanism were constant and continuous and affected by the environment and the eating habits. In man, this tendency was further accentuated by frequent mixed matings, physical variations and alterations, environmental changes and functional disuse.

2. Degenerative changes in the dental structures are known to have existed from the dawn of man, and it may not be overpresumptuous to assume that they may have had their origin during the transitory stages of dental development from the lower to the higher animals.

3. In primitive man, dental disease was largely due to excessive attrition of the teeth, and exposure of the pulp, followed by apical abscesses, but caries and decalcification were definitely less common than in contemporary man.

4. Pathologic conditions of the investing tissues prevailed in both prehistoric animals and man, but not in the degree observed in man of today.

5. Dental diseases are constantly increasing. They spare neither race nor people, young or old.

6. Clinically, we observe that the predisposition or immunity to either tooth degeneration or alveoloclasia is transmissible from parent to progeny.

7. The only possible solution of the problem of existing disharmonies rests on the logical application of the opportunities at our command and sincere endeavor on the part of civilized society. Science and modern technical knowledge, augmented by overwhelming stores of natural resources, can amply supply the needs, without exhausting our physical and mental energies to sustain life and health.

711 Doctors Building.

THE NEONATAL LINE IN THE ENAMEL AND DENTIN OF THE HUMAN DECIDUOUS TEETH AND FIRST PERMANENT MOLAR*

By ISAAC SCHOUR, D.D.S., Ph.D., Chicago, Ill.

HISTOLOGIC examination of human deciduous teeth selected at random reveals in the crown the presence of a distinctive incremental line in the enamel and a corresponding incremental line in the dentin. These distinctive lines appear at a level that is constant and characteristic for each tooth type. The purpose of this investigation was to establish the constancy and characteristic position of these lines and to determine their possible cause. Mr. M. Massler has given very valuable assistance in every phase of this work.

METHOD AND MATERIAL

A study was made of 250 deciduous teeth in decalcified serial sections and 100 deciduous teeth in ground sections. These were picked at random and were obtained for the most part through the courtesy of J. R. Blayney, Rudolf Kronfeld, F. B. Noyes and W. G. Skillen, who generously permitted examination of the collection of deciduous teeth that they had used in their respective investigations. There was a fairly uniform distribution of each deciduous tooth type.

In addition, a study was made of serial sections of the dentitions of two full-term infants, of a number of ground and decalcified sections of human permanent teeth and of twenty-six decalcified deciduous teeth of seven *Macacus rhesus* monkeys.

FINDINGS

The distinctive lines were found to be present in 90 per cent of the deciduous teeth that were examined. When teeth were decalcified and sectioned in complete serial order, the lines in the dentin were found to be present in every case. The lines were present in both the enamel and the dentin when ground sections were prepared that passed through the highest points of the dentino-enamel junctions, the points at which formation and calcification begin. In every case, the lines appeared at a characteristic distance from the dentino-enamel junction, depending on whether the tooth examined was a deciduous central incisor, lateral incisor, cuspid or first or second molar.

In the deciduous central incisor, the distinctive line in the enamel and the corresponding line in the dentin converge toward the dentino-enamel junction at a level which is within 1 mm. of the cemento-enamel junction. (Figs. 1-3.) In the deciduous lateral incisor, the convergence occurs at a slightly higher level. (Figs. 1, 4 and 5.) The deciduous cuspid shows a convergence above the mid-

*From the Department of Histology, College of Dentistry, University of Illinois.

*Presented in the form of a discussion and demonstration before the Ninth International Dental Congress of the F.D.I., Vienna, Aug. 3, 1936.

*This investigation has been aided by a grant from the Graduate School Research Board of the University of Illinois and from Mead Johnson and Company.

portion of the crown. (Fig. 1.) In the first deciduous molar, the distinctive lines are confined to the cusp level and bridge from one cusp to another. (Figs. 1 and 6.) In the second deciduous molar, the lines converge at the periphery of each cusp, but do not always cross the sulci. (Fig. 1.)

The lines could not be found in the teeth of the human full-term fetuses or in any of the permanent teeth that were examined except in the case of some permanent first molars. In these, the lines were confined to one or two cusps, usually the mesiobuccal cusp. (Fig. 1.)

The deciduous teeth of the *Macacus rhesus* monkeys also showed the distinctive lines at a level that corresponded to that observed in the human deciduous teeth. (Fig. 8.)

COMMENT

The striking constancy and characteristic position of these distinctive incremental lines in human deciduous teeth suggest that some constant and universal condition causes this phenomenon.

The absence of these distinctive lines in the teeth of full-term stillborn infants and their presence in the teeth of children only a few months of age suggested that the causative condition was present at some time at birth and soon after. Furthermore, the characteristic position of the lines in question was found to be identical with the characteristic surface of the enamel and dentin that obtains in the different types of deciduous teeth at the time of birth. Figure 1 *A* shows in semidiagrammatic form the amount of enamel and dentin formed in the teeth

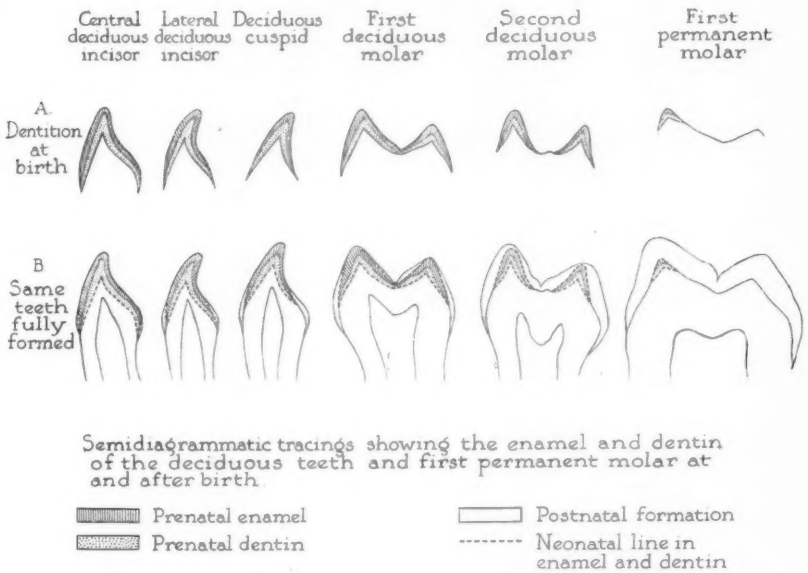

Central deciduous incisor
Lateral deciduous incisor
Deciduous cuspid
First deciduous molar
Second deciduous molar
First permanent molar
A. Dentition at birth
B Same teeth fully formed
Semidiagrammatic tracings showing the enamel and dentin of the deciduous teeth and first permanent molar at and after birth
Prenatal enamel
Prenatal dentin
Postnatal formation
Neonatal line in enamel and dentin

Fig. 1.—Enamel and dentin of deciduous teeth and first permanent molar at and after birth.

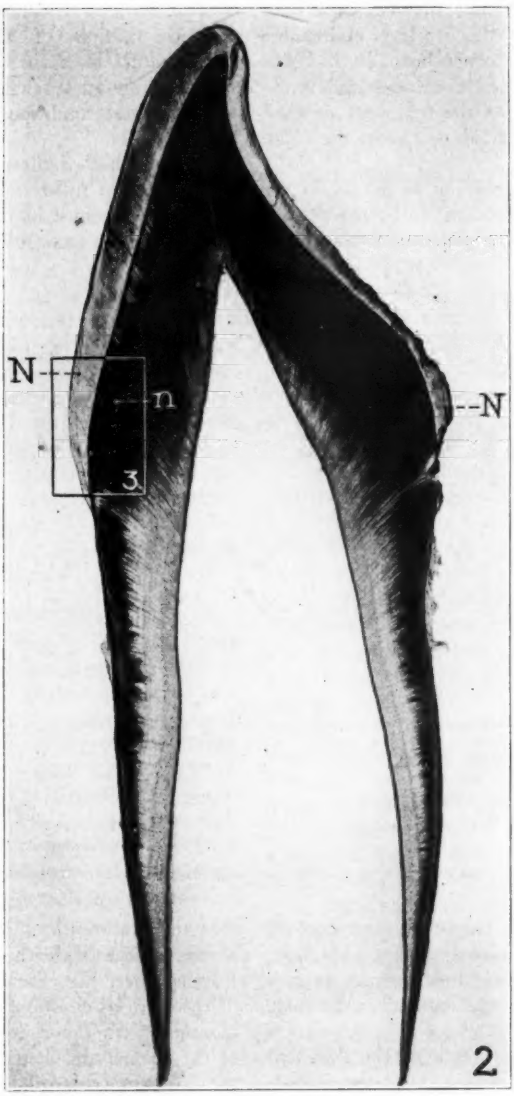


Fig. 2.—Ground section of upper deciduous central incisor. *N*, neonatal line in enamel; *n*, neonatal line in dentin. (×14.)

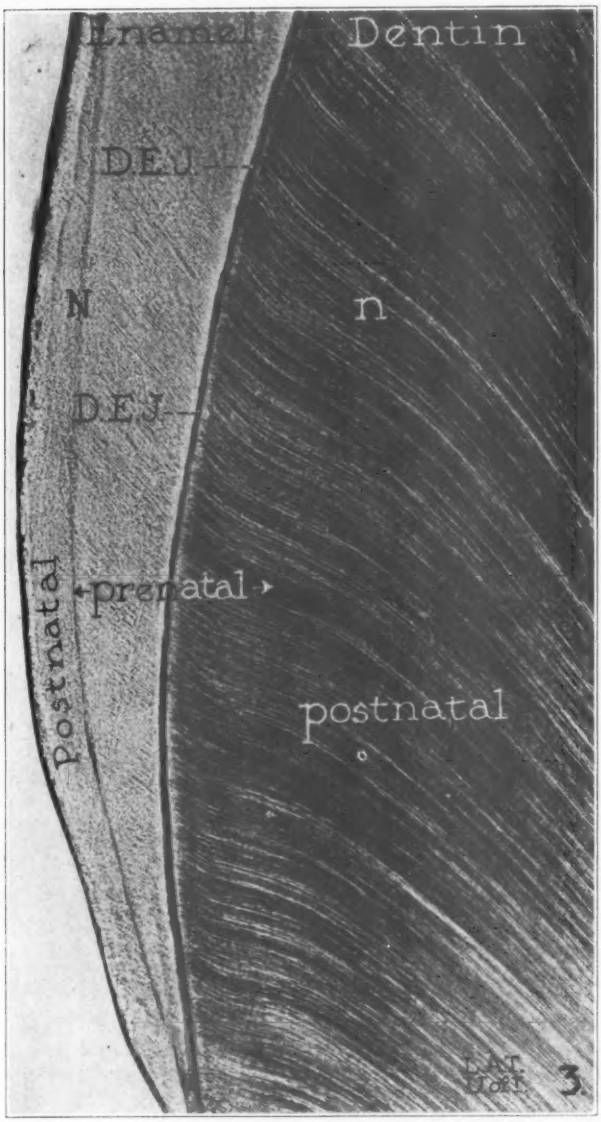


Fig. 3.—Enlarged view of field indicated at left in Figure 2. *N*, neonatal line in enamel; *n*, neonatal line in dentin; *D.E.J.*, dentino-enamel junction. (×92.)

of a full-term fetus. Figure 1 *B* shows in semidiagrammatic form the characteristic position of the distinctive lines in question in deciduous teeth and first permanent molars picked at random. The levels coincide exactly. It was therefore concluded that these distinctive incremental lines observed constantly in the crowns of deciduous teeth and sometimes in the first permanent molars are formed at and soon after birth. These lines may, therefore, be termed the neonatal lines in the enamel and dentin of the deciduous teeth.

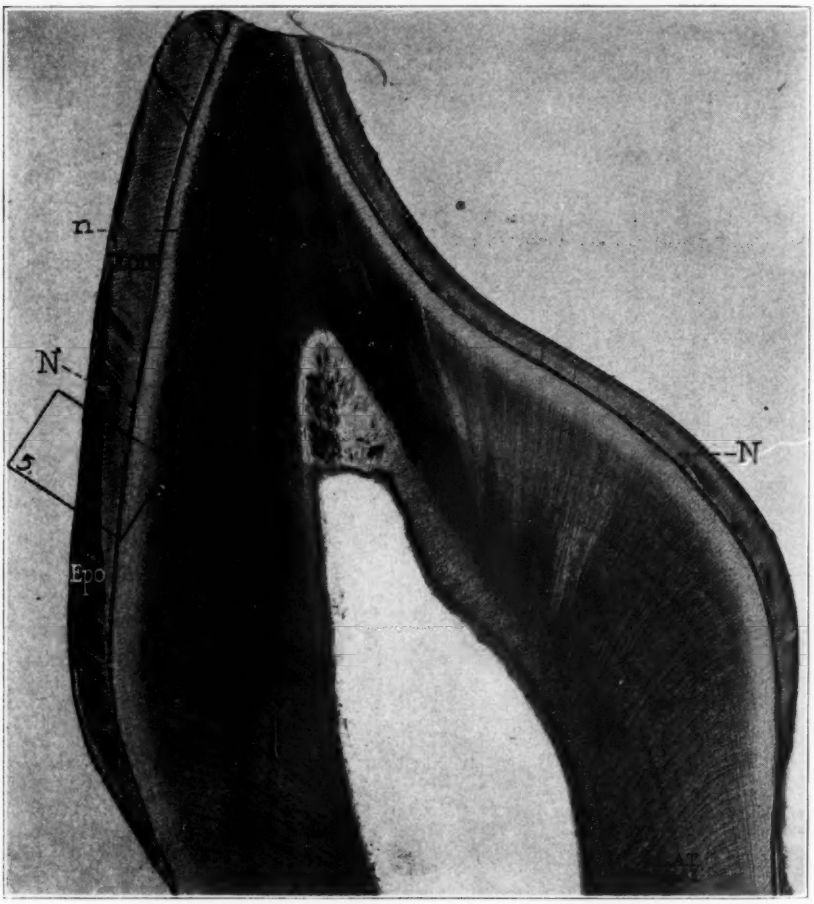


Fig. 4.—Crown of unstained ground section of deciduous lateral incisor. The prenatal enamel *Epre* stands out in marked contrast to the darker postnatal enamel *Epo*. *N*, neonatal line in enamel; *n*, neonatal line in dentin. (×21.)

The presence of the neonatal lines in some of the first permanent molars can be readily explained on the basis that a part of the crown is, in some instances, formed before birth.

Experimental Proof.—Further proof that the distinctive lines in the deciduous teeth are of neonatal origin was obtained from an experimental study of the rate of growth of human enamel and dentin by means of injections of small doses of sodium fluoride. (Schour and Poncher.[1]) Each injection of sodium fluoride produces a sharply accentuated incremental line in the enamel and dentin, forming at the time of the injection. (Schour and Smith,[2] 1935.)

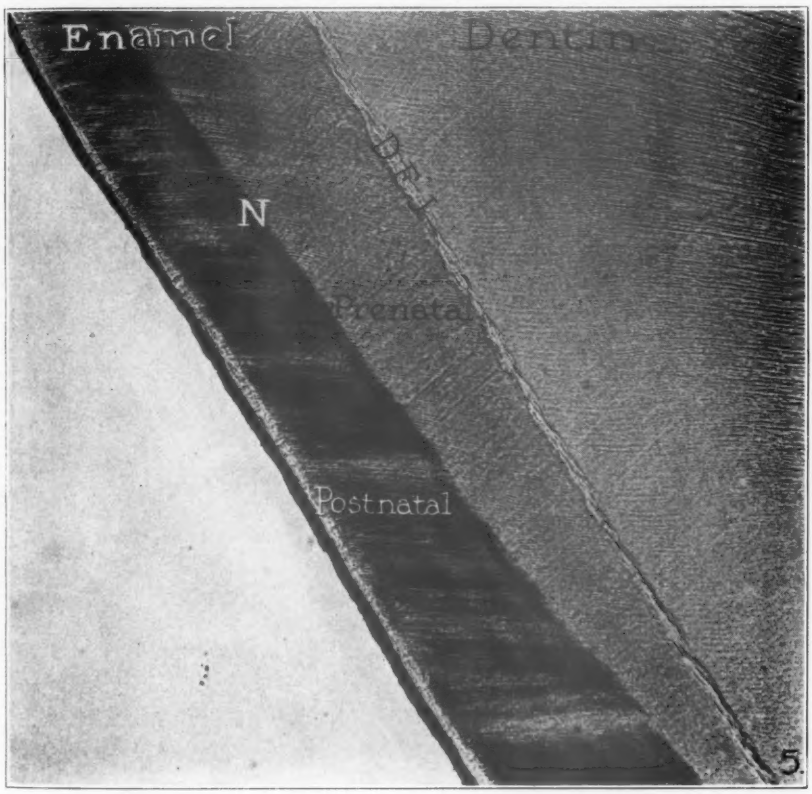


Fig. 5.—Enlarged view of field indicated at left in Figure 4. *N*, neonatal line in enamel; *D.E.J.*, dentino-enamel junction. (×115.)

1. Schour, Isaac, and Poncher, H. G.: Study on Rate of Apposition of Enamel and Dentin in Human Teeth, to be published.

2. Schour, Isaac, and Smith, Margaret C.: Mottled Teeth: Experimental and Histologic Analysis, J.A.D.A., 22:796-813 (May) 1935.

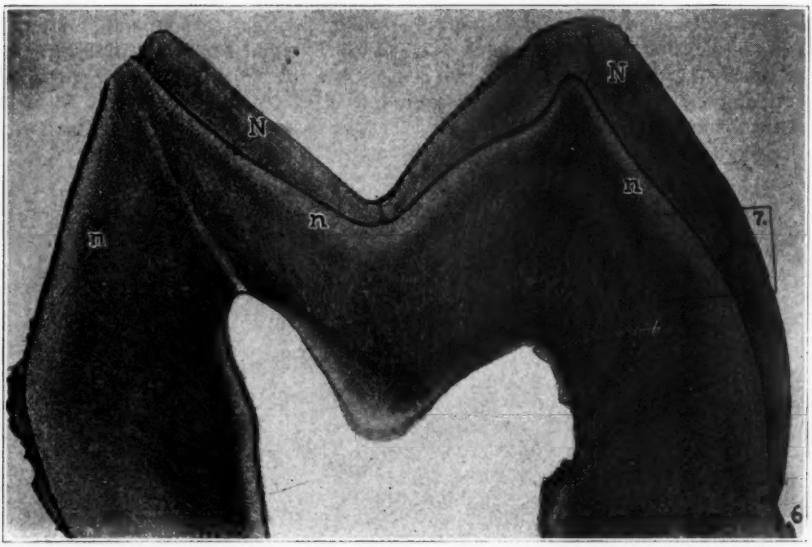


Fig. 6.—Crown of ground section of deciduous first molar. Part of the enamel was lost in grinding. *N*, neonatal line in enamel; *n*, neonatal line in dentin. The neonatal lines cross the sulcus. (×17.)

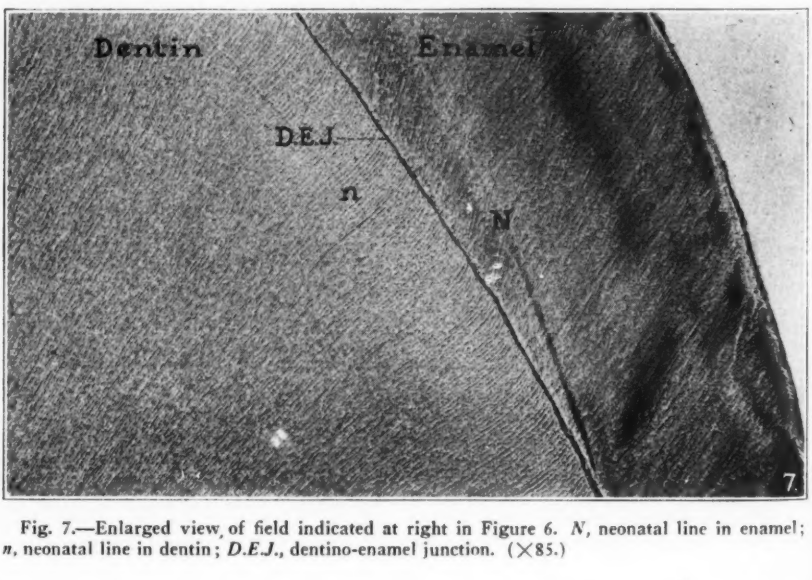


Fig. 7.—Enlarged view of field indicated at right in Figure 6. *N*, neonatal line in enamel; *n*, neonatal line in dentin; *D.E.J.*, dentino-enamel junction. (×85.)

The deciduous teeth in the experimental study showed a distinct line in the dentin that was formed some time before the injections were given. The position of this line corresponded to that of the neonatal line as indicated in Figure 1 *B*. The average distance between this line and the stripe that was produced by the first injection was measured. The approximate amount of daily apposition in this tooth (about 4 microns per twenty-four hours) being known, it was possible to estimate the time when the dentin which showed the line in question was formed. The date that was thus obtained was found to be the birthday of the child. This proved quantitatively that the neonatal dentin line was associated with the birth of the child. A corresponding neonatal line which formed at the time of the formation of the dentin line was found also in the enamel.

Neonatal Trauma.—It is not surprising that the severe metabolic disturbances which the new-born infant experiences during the time when it ceases its intra-uterine existence and has to adjust itself to the changes incident with extra-uterine life should leave their mark in the teeth. Under ordinary conditions, the new-born infant does not regain its birth weight until the end of the first ten days of extra-uterine life. Harris[3] (1933) has found

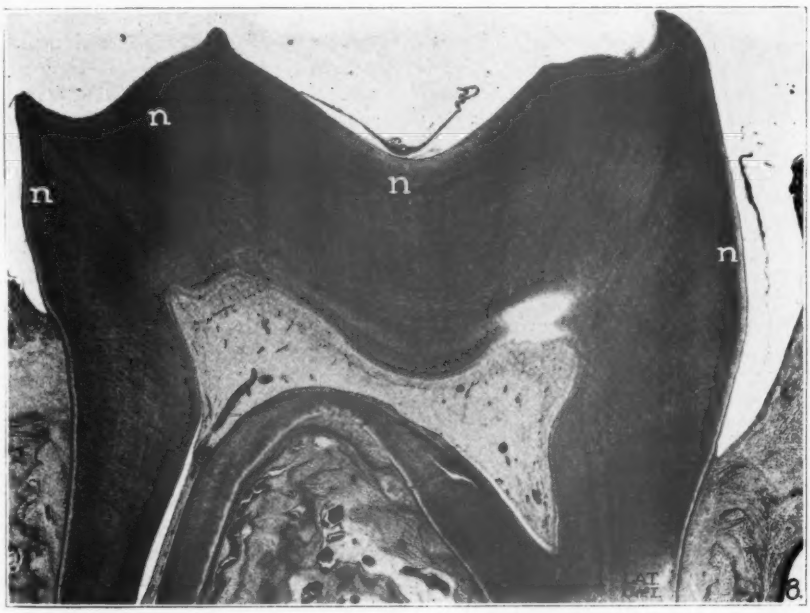


Fig. 8.—Crown of decalcified section of first deciduous molar from Macacus rhesus monkey. The position of the neonatal line, *n*, is analogous to that observed in the corresponding human tooth. The enamel is absent because of decalcification (×21.)

3. Harris, H. A.: Bone Growth in Health and Disease, London: Oxford University Press, 1933.

neonatal changes in bone and points out that "in neonatal life, as a result of the catastrophic changes involved at birth an arrest of growth concomitant with the loss of weight in the first week of life is of such frequency as to be almost a normal feature."

Stein[4] (1936) has attacked the problem of enamel disturbances in deciduous teeth from a clinical standpoint and suggested the possible explanation of some of these defects on the basis of a shock incident to birth.

The Delicate Response of the Growing Dental Tissues.—Experimental studies have repeatedly shown that the teeth are delicate and accurate recorders of metabolic disturbances. (Erdheim[5] [1906]; Schour and van Dyke[6] [1932]; Schour, Tweedy and McJunkin[7] [1934]; Schour and Rogoff[8] [1936].)

Erdheim[9] (1911) pointed out that the dentin of the rat incisor acts like the drum of a kymograph, in which are recorded the disturbances in calcium metabolism in an accurate and easily readable manner. The existence of the neonatal lines in the enamel and dentin of the human deciduous teeth confirms Erdheim's comparison and amplifies it. His analogy is applicable to the enamel as well as the dentin; to metabolic changes as well as calcium metabolism changes, and to the growing tissues of the human incisor as well as the rodent incisor.

The delicacy of the enamel and dentin reaction is well illustrated by the fact that, in a number of sections, the enamel and dentin that preceded the time of the formation of the neonatal lines differed markedly from the enamel and dentin that was formed subsequently. In decalcified sections stained with hematoxylin-eosin, the prenatal dentin stained more deeply with hematoxylin than did the postnatal dentin. (Fig. 9.) In ground sections, the prenatal enamel appeared to be better calcified than the postnatal enamel. (Fig. 5.) The indications are that the prenatal calcification of the enamel and dentin is often better than the postnatal one.

CONCLUSIONS

The establishment of the neonatal lines and their constancy and characteristic position in the enamel and dentin of human deciduous teeth and the first permanent molars paves the way for a number of new investigations in the histology and the biology of the human tooth. The neonatal lines constitute a permanent biologic landmark which can be used for the determination of the amount and quality of the enamel and dentin laid down before and after birth. They also mirror the biologic changes in the dental tissues of the new-born child that may result from metabolic influences that are incident to a change from intra-uterine to extra-uterine existence.

SUMMARY

A microscopic analysis of decalcified

4. Stein, Georg: Schmelzschäden am Milchgebiss und ihre klinische Bedeutung, Ztschr. f. Stomatol., 34:843-862 (July-Aug.) 1936.

5. Erdheim, J.: Tetania parathyreopriva, Mitt. a. d. Grenzgeb. d. Med. u. Chir., 16:632-744, 1906.

6. Schour, Isaac, and van Dyke, H. B.: Changes in Teeth Following Hypophysectomy. I. Changes in Incisor of White Rat, Am. J. Anat., 50:397-433 (July) 1932.

7. Schour, Isaac; Tweedy, W. R., and McJunkin, F. A.: Effect of Single and Multiple Doses of Parathyroid Hormone on Calcification of Dentin of Rat Incisor, Am. J. Path., 10:321-342 (May) 1934.

8. Schour, Isaac, and Rogoff, J. M.: Changes in Rat Incisor Following Bilateral Adrenalectomy, Am. J. Physiol., 115:334-344 (April) 1936.

9. Erdheim, J.: Ueber die Dentinverkalkung im Nagezahn bei der Epithelkörperchen-transplantation, Frankfurt. Ztschr. f. Path., 7:295-342, No. 2, 1911.

and ground sections of 350 human deciduous teeth picked at random shows, in 90 per cent of them, the presence of a distinctive incremental line in the enamel and a corresponding incremental line in the dentin of the crown. The position of these lines is characteristic for each tooth type and corresponds to the surface of the enamel and dentin that obtains at the time of birth. In some permanent first molars, similar lines are found at the level of the cusps which were formed and calcified at birth.

A histologic analysis of the teeth of a human infant whose complete chronologic history was available offered experimental evidence that these distinctive incremental lines are associated with the birth of the child. It is suggested that these lines are caused by the metabolic changes resulting from the experience that the infant undergoes at birth and during its neonatal life.

These incremental lines are, therefore, termed the neonatal lines of the enamel and dentin of human deciduous teeth and the first permanent molars. As stated, they constitute a permanent biologic landmark which can be used to determine the amount and also the quality of the enamel and dentin laid down before and after birth. The establishment of the neonatal lines paves the way for a number of investigations in the biology of the human tooth and of the newborn child.

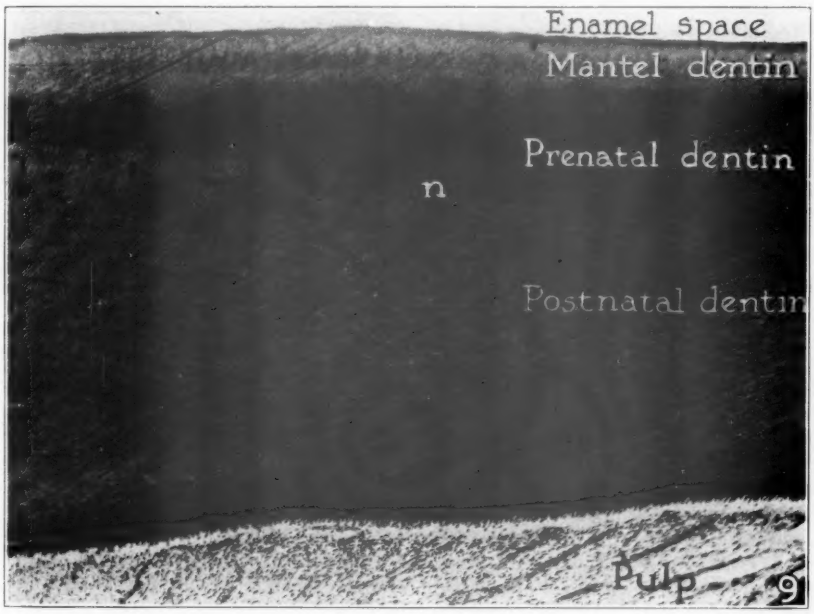


Fig. 9.—Gingival portion of dentin from decalcified section of upper deciduous lateral incisor; stained with hematoxylin-eosin. The hematoxylin-stained prenatal dentin is darker. *n*, neonatal line in dentin. (×80.)

1838 West Harrison Street.

ORAL SURGICAL PROCEDURES (NOTES ON A NATURAL COLOR MOTION PICTURE)*

By HARRY J. FIELD and ALFRED A. ACKERMAN, D.D.S., Newark, N. J.

MOTION pictures are coming rapidly to the fore as an educational force. Perhaps in no field is this statement more accurate than in that of oral surgery. Because of the comparatively small size of the oral operative zone, it has hitherto been impossible for more than a handful of men to get a clear vision of the operative procedure. With the advent of the modern motion picture camera, it is now possible to portray closeup views of oral surgical procedures which, when projected on a large screen, can be clearly seen and studied by large audiences. Since splicing lengthy subtitles into the film tends to break the continuity of the action, we have decided to preface the films with this short paper, which will explain the highlights of the action seen on the screen.

The first case is that of a typical radicular cyst in the lower anterior region of the mandible involving the four incisor teeth, which were previously removed to effect drainage. When the acute symptoms subsided, the cyst was enucleated. The outstanding point in technic that is to be emphasized in this case is the preservation of the ridge; both the buccal and lingual plates of bone being maintained. After the reflection of an adequate flap, the cyst is entered through a window cut through the buccal plate, well below the ridge. When the cystic tissue is enucleated, the flap is replaced and sutured in position. Healing occurs by first intention, no dressings being needed. Preservation of the ridge is important from the prosthetic point of view, since the loss of the buccal wall of bone can be compensated only by using long unsightly facings for the ultimate restoration.

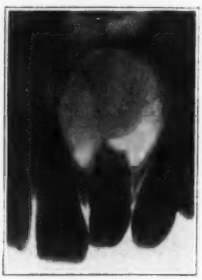


Fig. 1.—Radicular cyst over upper lateral incisor. In enucleating these cysts, the preservation of the labial plate of bone at the ridge is essential to minimize deformity.

In the second case, the plastic removal of a low frenum and the extraction of the upper teeth are seen, followed by alveolectomy. The plastic elimination of a low frenum is a very simple operation, but it is almost impossible to describe it verbally. In the film, the procedure is readily seen and the technic instantly grasped. During the alveolectomy, the index finger, it is observed, is used to test the bone for sharp margins. The bone file and rongeurs are the instruments used.

*Read before the Oral Surgery Section of the Rochester Study Club, and the Gilead Dental Club, Rochester, N. Y., January, 1936.

The third case presents the surgical removal of an impacted upper cuspid embedded in the palatal process. The central and lateral incisors have been tested for vitality with the electric pulp tester; a routine measure in all cases of impacted cuspids. The flap is broad and is reflected directly from the gingival margins of the teeth. Interference from the flap is avoided by tying it with a suture to the bicuspid on the opposite side. The bone over the crown is removed with hand pressure ossisectors. The complete exposure of the crown is essential before the application of elevator force. The central and lateral incisors are supported whenever the lever is applied to the cuspid. In this connection, it is our conviction that any operation for the removal of an impacted cuspid that results in the loss of either the central or the lateral incisor must be considered a failure. After re-

Fig. 2.—Case shown in Figure 1. The labial ridge of bone has been preserved.

Fig. 3.—Preoperative and postoperative view of apicoectomy.

Fig. 4.—Extensive cystic degeneration of anterior palatine foramen.

Fig. 5.—Photograph taken at moment of evacuation of deep pocket. A thick stream of pus is clearly visible coursing down the face.

moval of the impacted tooth, all bone spiculae are removed and all sharp margins of the bone are trimmed and smoothed. The flap is returned to place, no sutures or dressings being used.

Our observation has been that in these cases, healing is rapid and by first intention.

The fourth case is an apicoectomy on an upper lateral incisor. The roentgenogram reveals an adequate alveolar attachment to insure a satisfactory result. If cases are carefully selected, this operation is practically 100 per cent successful. The outstanding points to look for may be listed as follows:

1. There must be at least two-thirds of the normal bony support of the root present after amputation of the apex.

2. The tooth must not be in traumatic occlusion.

3. The root-canal therapy must be carefully carried out under aseptic conditions by the general practitioner.

In the case shown, the flap is reflected from the gingival margin. The unsightly scar resulting from the usual half moon type of incision is thus avoided. The apical region is entered with hand pressure cutting instruments. The removal of the apex with the Feldman bibevel drill is also a variation from standard technic. The drill removes the largest part of the apex rapidly and with a minimum of trauma and is superior to most means of removal of the apex. The root end is finished down with a round surgical bur with closely spaced blades. In these cases, too, the flap is replaced and sutured into position, no dressings being used and healing being permitted to occur by first intention.

The next case shown is an unusual type of cyst. To our knowledge, these cases were first called to the profession's attention by Dr. Schroff of New York City. They are cases of cystic degeneration of the anterior palatine foramen. This one is the largest that we have ever seen. The cyst seems to have involved all six anterior teeth and the two bicuspids on the right side. Actually, these teeth all responded normally to the electric pulp tester. Here, too, as in the cuspid operation, the flap extends from the gingival margins. Of course, a much more extensive flap is needed in this case. The opening into the cyst cavity is created with chisel and mallet. The entire cystic membrane is enucleated and no teeth are removed. A broad flap of this type lends itself readily to replacement without sutures. No dressings are used.

The last cases demonstrate the handling of extensive jaw infections that have resulted in external pointing. When fluctuation is detected in these cases, external incision is the only means of providing complete and adequate drainage. To vacillate over such a measure is bad judgment and may lead to more serious complications. The steps in this procedure are as follows: (1) cleansing of the skin followed by sterilization with tincture of iodine; (2) incision of the fluctuant skin with a keen-edged blade; (3) blunt dissection of the underlying soft tissue until a wide path leading to the lower border of the mandible is prepared; (4) evacuation of all "pockets" by use of hemostats, and (5) insertion of a deep drain.

SUMMARY

These cases were selected because they represent, with the exception of the cyst of the foramen, ordinary straightforward cases seen in the average active dental office. The high lights of the operative procedures may be briefly listed as follows:

1. The labial plate of bone should never be removed to provide access to cysts in the anterior region.

2. Prior to operation for removal of impacted cuspids, the central and lateral incisors should be tested for vitality. A cuspid operation may be considered a failure if it results in the loss of either the central or the lateral incisor.

3. Reflection of the flaps from the gingival margins is carried out in almost all surgical cases.

4. A drill is used to remove the apex in apicoectomies.

5. When teeth that appear to be involved by cystic conditions respond normally to the electric pulp tester, their retention is advised.

6. Elimination of dressings or "packs" whenever possible allows the wounds to heal by first intention.

130 Market Street.

SIGNIFICANCE OF FUSIFORM BACILLI AND SPIRILLA IN GINGIVAL TISSUE*

By RUTH TUNNICLIFF, A.B., M.D.; E. B. FINK†, Ph.D., M.D., and CAROLYN HAMMOND, M.A., Chicago, Ill.

RAUCHFUS was probably the first to note the association of fusiform bacilli and spirilla in a morbid process. This observation was made in 1893. Since then, Plaut, in 1894, Vincent, in 1896, and many others have observed the presence of these micro-organisms in ulceromembranous conditions of the mucous membranes and in the skin and brain.

There is a difference of opinion as to the importance of these organisms on account of their common occurrence and our inability to reproduce the lesions except with mixed cultures. They are looked on by some[1] as being of no pathologic significance. There is considerable evidence that fusiform bacilli and spirilla become pathogenic when the vitality of the tissue has become impaired. This is substantiated by the observation of Wallace, Wallace and Robertson[2] that Plaut-Vincent's infection of the mouth develops in dogs that receive injections of scillaren B, and by the experiments of Miller and Rhoads,[3] who observed in dogs an ulcerative stomatitis, generally showing spiral organisms and fusiform baccilli, from a diet causing black tongue.

The observations of Wallace, Wallace and Robertson are valuable in showing definitely the different stages in the formation of the lesion. Typical smears of Vincent's infection are not seen in the dog until necrosis occurs. During the first three days, all the fusiform bacilli are small, the large typical "cigar"-shaped bacilli becoming numerous about the sixth

*From the John McCormick Institute for Infectious Diseases and the Foundation for Dental Research of the Chicago College of Dental Surgery.

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-Eighth Annual Session of the American Dental Association, San Francisco, Calif., July 14, 1936.

†Deceased.

1. Lichtenberg, H. H.; Werner, M., and Leuck, E. V.: J.A.M.A., 100:707 (March) 1933.

2. Wallace, H.; Wallace, E. W., and Robertson, O.: J. Clin. Investigation, 12:909 (Sept.) 1933.

3. Miller, D. H., and Rhoads, C. P.: 61: 173 (Feb.) 1935.

day, when the spiral forms and necrosis appear.

Although typical fusospirillar lesions have not been produced with pure cultures of fusiform bacilli, one of us (R.T.) and Klein[4] have produced abscesses in the skin of guinea-pigs with nonvirulent strains of fusiform bacilli by first preparing the area with injections of scillaren B, continued until the animal becomes slightly ill. Smears and sections of these abscesses show both bacilli and spirilla-like organisms.

The strongest evidence of a causal relationship between fusiform bacilli and spirilla and the necrotic processes with which they are associated is furnished by microscopic examination of sections of the involved tissues.[5] Most observers agree that the exudate on the surface contains cocci, fusiform bacilli and spirilla and that necrosis occurs only after the tissue is invaded by the bacilli; that, between the necrotic and living tissues, there is an area containing enormous numbers of spirilla and fusiform bacilli in palisade

Fig. 1.—Cross-section of pyorrheal tissue, showing fusiform bacilli invading living tissue. (Modified Warthin stain; ×1900.)

4. Tunnicliff, Ruth, and Klein, J.: J. Infect. Dis., 55:380 (Nov.-Dec.) 1934.

5. Perthes: Arch. f. klin. Chir., 59:111, 1899. Buday: Beitr. z. Path. Anat. u. z. Allg. Path., 38:253, 1905. Ellerman: Centralbl. f. Bakt., 38:383, 1905. Stewart: J. Path. & Bact., 16: 221, 1911. Tunnicliff, Ruth: J. Infect. Dis., 25:132 (Aug.) 1919. Diamond, J. S.: Am. J. Digest. Dis. & Nutrition, 2:698 (Jan.) 1936.

formation, and that these micro-organisms invade the living tissue, the spiral forms definitely in advance of the bacillus. Gram-Weigert stains show no cocci in the living tissue.

The histologic appearance of the tissues depends on the amount of cellular reaction of the living tissue. The less marked the reaction, the greater the invasion of the organisms. The inflammation is generally fibrinous and shows a variable number of polymorphonuclear leukocytes

Fig. 2.—Cross-section of upper second molar with deep pyorrhea pockets (*A* and *C*) and granulation tissue in the bifurcation of the roots (*B*).

and proliferation of connective tissue cells. According to Stewart, fatal cases show practically no reaction locally, no proliferation of fixed tissue cells and only an occasional polymorphonuclear cell.

Smears from pyorrhea alveolaris and ulceromembranous gingivitis are confusing, since they both show large numbers of fusiform bacilli and spirilla. It seemed of interest to compare sections of the tissues in these two conditions to determine the degree of invasiveness of these organisms.

Many studies have been made of sections of lesions showing these organisms in the tonsil, lung, face and skin, but gingival tissues do not appear to have been suitably stained to demonstrate fusiform bacilli and spirilla, which are gram-negative and difficult to stain in tissues.

Fisher[6] did not observe any invasion of living periodontal tissue by fusiform bacilli and spirilla, in pyorrhea, although they occurred in large numbers in smears obtained superficially. Unfortunately, he did not use a silver preparation for staining these organisms deep in the tissue. His material was obtained postmortem.

Sections of tissue for this study were obtained from one case of facial gangrene, one case of superficial ulceromembranous gingivitis, sixteen cases of pyorrhea during life and three cases of pyorrhea postmortem. A tooth extracted during life with some attached living tissue and the three postmortem specimens containing the whole tooth and the jaw bone with the surrounding soft tissue were fixed in 10 per cent formalin, decalcified in 5 per cent nitric acid for twelve days, put in sodium sulfate and left twenty-four hours, rinsed and dehydrated in alcohols. These specimens were embedded in celloidin, cut and stained.

The pieces of gum tissue obtained during life were removed under local anesthesia from the lower incisor region with a sharp knife and periosteal elevator. The biopsy specimens were from 1 to 2 cm. long and extended to the bone. These tissues were embedded in paraffin. All of the tissues were stained with silver. At first, the Levaditi method was used. Later, a

6. Fisher, J. H.: Am. J. Path., 3:109 (March) 1927.

modified Warthin[7] stain was employed. Except in two instances, when too little material was obtained, the tissues were also stained by Gram-Weigert stain and by hematoxylin-eosin.

Histologically, sections of pyorrheal tissue stained with hematoxylin-eosin show focal areas of thickening of the epithelium. The most marked reaction is in the subepithelial connective tissue, where there are focal areas of monocytic infiltration 90 per cent of which are plasma cells. The inflammatory reaction is most marked in the deeper dense fibrous connective tissue, but extends up the papillae to the epithelium. Where the epithelium has been cut in such a way that the papillae are surrounded by epithelial cells, the connective tissue is infiltrated with monocytes. The cellular reaction is most marked in the tissue next to the periodontal membrane and slight near the epithelium. The type of reaction is a nonspecific chronic inflammation of the gingival tissues. The specimens vary in the degrees of inflammation.

The tissues from ten pyorrheal patients show no invasion by bacteria. Superficial invasion by only fusiform bacilli (Fig. 1) is seen in three; by fusiform bacilli and spirilla in two, and by fusiform bacilli associated with gram-positive filaments and cocci in three. Spirilla alone are observed invading living tissue, once, in a severe pyorrheal infection.

Fig. 3.—Cross-section of pyorrheal tissue, showing spirilla invading living tissue. (Fig. 2, *B*.) (Modified Warthin stain; ×1200.)

The three postmortem specimens and the tissue attached to the extracted tooth show soft tartar intact between the tooth and gingival tissue. In this material is

7. Warthin, A. S., and Olsen, R. E.: Am. J. Syph., 15:145 (April) 1931.

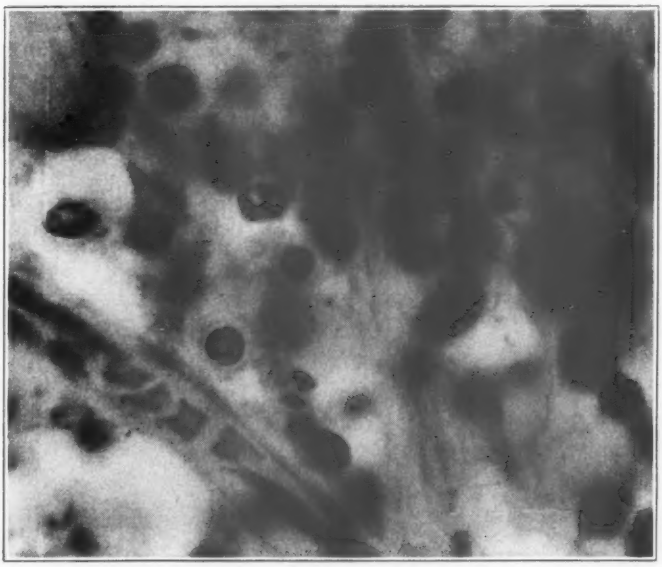


Fig. 4.—Area shown in Figure 3 stained with hematoxylin-eosin. (×1200.)

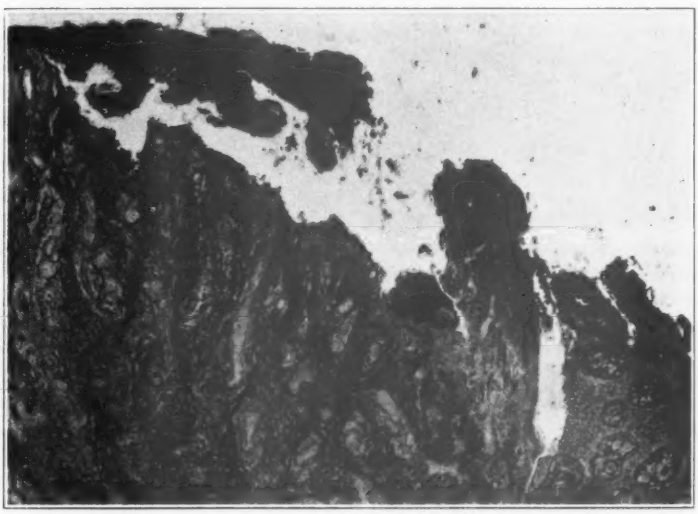


Fig. 5.—Cross-section through superficial ulceromembranous gingivitis showing erosion of tissue by fusiform bacilli and spirilla. (Levaditi stain; ×70.)

seen masses of actinomyces-like organisms *(Vibriothrix dentium)*[8] and large numbers of filaments and cocci. In the pus between the soft tartar and gingival tissue, large numbers of spirilla are present. In two cases, no spirilla are observed invading living tissue. In one severe case (Fig. 2) with much granulation tissue at the bifurcation of the roots, three areas of infection are present, all showing large numbers of spirilla unassociated with bacteria are seen on the surface and invading the living tissue attached to the tooth extracted during life. A rare observation is the presence of an occasional fusiform bacillus and filament in advance of the spirilla.

When fusiform bacilli and spirilla invade pyorrheal tissue, the bacilli are fewer, while the spirilla are more numerous, than in ulceromembranous conditions.

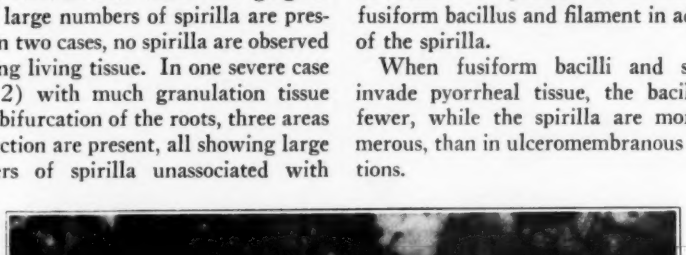


Fig. 6.—Specimen shown in Figure 5. Fusiform bacilli and spirilla are invading the tissue, the spirilla in advance of the bacilli. (×1600.)

other bacteria (Gram-Weigert and silver stains) (Fig. 2, *A, B, C*) and, in all three places, the spirilla are invading the living connective tissue. (Fig. 3.) As many as three spirilla are observed in some blood vessels.

A few fusiform bacilli and large numbers of spirilla unassociated with other

The sections from the gangrenous facial tissue and the superficial ulceromembranous gingivitis (Figs. 5-6) are similar except that the former shows a wider area of necrosis. Large numbers of fusiform bacilli in palisade formation and spirilla are present in the necrotic tissue. Both fusiform bacilli and spirilla are seen invading the living tissue, the spirilla being considerably in advance of the ba-

8. Tunnicliff, Ruth, and Jackson, L.: J. Infect. Dis., 46:12 (Jan.) 1930.

cillus. No cocci are observed in the living tissue.

IMMUNITY TESTS

It was believed that immunity tests might throw some light on the rôle of fusiform bacilli in lesions in and about the mouth. Since spirilla resembling those found in fusospirillar lesions have not been isolated, a pure culture of a freshly isolated fusiform bacillus was used for the suspension. Certain cultures contained filaments, but no cultures with the spirilla-like forms of fusiform bacilli were available. Changes in immunity reactions to this organism would not determine its etiologic relation, but would indicate that there was a reaction between the blood of the patient and the micro-organism. We chose the opsonic test because of its simplicity and because a previous observation of one of us (R.T.)[9] showed that a patient with noma had a low opsonic index (0.4) to a fusiform bacillus from a case of gingivitis. The method of Veitch[10] was used. He estimated the amount of phagocytosis of an organism in a mixture of patient's whole citrated blood and compared it with that of normal. Whole blood is drawn up into an equal part of 2 per cent sodium citrate solution in salt solution in a bent capillary pipet (to a point 4 inches or 10 cm. on the drawn-out end) and thoroughly mixed in the bend of the pipet. To this, an equal amount of the fusiform bacillus suspension is added at once and the contents of the pipet again mixed. The mixtures are incubated twenty-five minutes and stained with Giemsa stain and the percentages of polymorphonuclear leukocytes taking part in phagocytosis noted (phagocytic index). The blood of a normal person is tested in the same way and used as a control. The bacilli are grown anaerobically on sheep blood-agar from forty-eight to seventy-two hours and suspended in salt solution for the test. One hundred cells are counted.

The blood of a patient with ulceromembranous gingivitis was examined at the onset of the infection before treatment. The phagocytic index was 0.67. After treatment, with improvement, the index rose to 4.7, and, with recovery it returned to normal, 0.85.

The indices of ten untreated pyorrheal patients vary from 0 to 0.75, the average index being 0.3. The indices of five patients improved, clinically, by treatment vary from 2.5 to 20.0, the average index being 7.4. One patient clinically cured, but still showing large numbers of fusiform bacilli and spirilla on the gums, has an index of 3.5. This patient might be considered a carrier. Another patient with a chronic infection in the mouth, not associated with these organisms, has an index of 1.0.

SUMMARY

Smear preparations from ulceromembranous and pyorrheal gingivitis both show large numbers of fusiform bacilli and spirilla. Sections of pyorrheal tissue stained with silver indicate that while a few fusiform bacilli may occasionally be found in the tissues, although not in such large numbers as in ulceromembranous conditions, the spirilla may invade living tissue in larger numbers, particularly in severe pyorrheal infections.

The fact that immunity tests (phagocytic) on patients with pyorrhea and ulceromembranous gingivitis both show definite reactions to cultures of fusiform bacilli suggests that this micro-organism may be of pathogenic significance.

9. Tunnicliff, Ruth: J. Infect. Dis., 8:310, 1911.

10. Veitch: J. Path. & Bact., 12:353, 1908.

The Journal of the American Dental Association

212 East Superior St., Chicago, Ill.

C. N. JOHNSON, Editor

Published by the American Dental Association

All expressions of opinions and all statements of supposed facts are published on the authority of the writers over whose signature they appear, and are not to be regarded as expressing the views of the American Dental Association, unless such statements or opinions have been adopted by the Association.

Communications intended for publication in the scientific or literary pages of THE JOURNAL should be addressed to the Editor. All advertising or business matter should be sent to the Business Manager.

Subscription is included in the annual membership dues. The subscription rate to nonmembers is $5.00 a year in advance, this rate applying to both domestic and foreign subscribers. All foreign subscriptions are to be paid in United States money.

Editorials

THE NINTH INTERNATIONAL DENTAL CONGRESS

The recent Ninth International Dental Congress of the Fédération Dentaire Internationale, held in Vienna, Austria, Aug. 2-8, 1936, marks another milestone in the progress of international dentistry and one particularly outstanding when considered from the standpoint of membership and attendance, which were far above what could be expected under the general economic and disturbed political conditions prevailing throughout the entire world at the time of the meeting. Representatives from forty-seven countries responded to the roll call of nations at the opening exercises. The American Dental Association was well represented in both the scientific and the clinical programs, as well as in the scientific exhibits.

The buildings used for the sessions of the Congress were situated in the center of the city, close to the leading Viennese hotels; which proved to be very advantageous in connection with attendance upon the various meetings. The scientific and industrial exhibitions were housed in one building, and the reading of the

papers, reports and discussions took place in another. The buildings were connected by a covered passage and a beautiful garden, which constituted a very dignified setting for the meetings in both buildings.

The Congress was divided into fifteen sections, three sections functioning at the same time in different rooms, and each section holding but one session. In this way, the working program was completed in five days. The mornings were devoted to the reading of reports, papers and discussions, and the afternoons to clinics and demonstrations of the subjects covered in the morning sessions.

A special innovation of this Congress was a device that enabled the visitors to hear the reading of papers or reports in any one of the official languages of the Congress. The papers were translated at the time that they were being read and sent over a microphone to a transmitter to which headphones had been attached. By adjustment of the headphones, a visitor could choose the language with which he was most familiar, this making it possible to follow the reading of any papers in which he was particularly interested, or the description of any illustration that might be thrown on the screen.

Attention can appropriately be called to the fact that at this Congress, the reports and discussions covered only those activities of the last five years, 1931 to 1936, or the period that elapsed between the Eighth and Ninth International Dental Congresses. Such a plan precludes the possibility of presenting the same material before successive sessions of international dental congresses; and herein may be established a precedent that, at least in principle, might be accepted with profit by all national dental associations, especially in connection with the general sessions and perhaps to a less restricted degree, to the programs of sections. (This observation is taken in part from a report presented by W. H. G. Logan as Chairman of the F.D.I. Committee of the A.D.A. to the House of Delegates at San Francisco, July, 1936.)

Dr. Georges Villain of Paris closed his tenure of office as president of the Fédération Dentaire Internationale for the past five years with a very dignified address. Before his election to the

presidency, he had served as secretary of this organization for a five-year period. During this decade of service to the Fédération Dentaire International, his contributions to international dentistry have been outstanding.

The Miller Memorial Prize was presented to the following worthy candidates at the opening session of the Congress, by Dr. Georges Villain on behalf of the Fédération Dentaire Internationale: Drs. Maurice Roy, of Paris; Bernhard Gottlieb, of Vienna, and A. Cieszynski, of Poland. This prize is now awarded every five years to at least one or at the most to five recipients. The candidates are nominated by the national committeemen of their respective countries at the meeting of the Executive Council of the F.D.I., which occurs two years previous to the succeeding international dental congress; and the following year, the Executive Council chooses the recipient or recipients.

At the close of Dr. Villain's presidential address, Dr. Hans Pichler of Vienna was formally installed as president of the Ninth International Dental Congress. An address of welcome was presented to the representatives of the visiting nations by a representative of the federal president of Austria.

As a result of a request of the Austrian government to the Secretary of State of the United States of America, and by appropriate action of the Trustees of the American Dental Association, government delegates were selected from the membership of the American Dental Association to represent the United States at the Congress. Delegates were also selected by the American Dental Association to represent the parent organization, and a certain number of state societies and a few of their component societies, as well as educational institutions of the United States, selected delegates to represent their respective organizations.

The United States Minister to Austria, Mr. George S. Messersmith, received our national delegates at the Embassy, and a tea was tendered all members of the dental profession from the United States and their wives, more than one hundred being present. This gracious hospitality on the part of our Minister and Mrs. Messersmith was appreciated by all the Americans, and each one came away with the firm conviction that the United

States is represented not only by a fine type of American citizen, but also by one well versed in national and diplomatic responsibilities.

The Austrian Local Arrangements Committee provided an unusual diversification of entertainment in the form of receptions, banquets, teas, sightseeing trips, concerts and dancing. Among these should be mentioned the dinner given by the president of the Congress, Dr. Hans Pichler, for the members of the Executive Committee of the F.D.I., the leaders of the national delegations and the reporters; the reception for Congress members given by representatives of the Austrian government; the reception at the Vienna City Hall by the Mayor of the city; the garden party in the Burg Gardens; the official dinner in the ceremonial rooms of the Imperial Palace, and the Viennese orchestral concert, with selections from the operas of famous Viennese composers. In addition, special entertainment was provided for the ladies. The sincere and whole-hearted hospitality of the Viennese people as shown in their eagerness to make their visitors happy and comfortable was quite typical of the spirit of Continental Europe, and not only won its way into the hearts of the Americans, but also embued them with a desire to become better acquainted with these people and their countries.

The next meeting of the Fédération Dentaire Internationale will be held in Stockholm in 1937, and the Tenth International Dental Congress in London in 1941.

Dr. William H. G. Logan of Chicago was elected president of the Fédération Dentaire Internationale for the next five years. Dr. Charles F. L. Nord of The Hague, Holland, and Dr. A. E. Rowlett of Leicester, England, were reelected secretary and treasurer, respectively.

We cannot close without a word of congratulation to our Chicago colleague, Dr. Logan, on his ascendancy to the presidency of the F.D.I. For many years, he has been prominent among the councils of this great international body, and it is therefore very fitting that he should have been honored by being placed at its head. The interests of international dentistry will be in safe keeping with him at the helm, and we bespeak for him the loyal sup-

port and hearty cooperation of every leading dentist in the world. If the same uniformity of sentiment and camaraderie displayed by the dentists of the different nations could be emulated by the political powers of these same nations, we would soon have a different and a very much better world.

WE NEED BOTH

No one will argue for a moment that there is not an insistent demand for the highest possible development of the science and art of our profession. It is ostensibly for this that students are trained in college. They are taught the technic of dentistry to the end that they may acceptably perform the necessary operations to take care of their patients, and they are taught the science of their profession so that they may have a reason for every one of their technical procedures.

The need for all of this is fundamental. It is accepted everywhere as part and parcel of every student's training, and the curriculum is carefully built up with this end in view. Most of the tests that are submitted to dental students for examination are grouped around the objectives embodied in a knowledge of the science and art of our calling, and it is largely on this basis that our legislative authorities pass judgment as to whether a candidate is to be admitted to practice.

This has naturally led to a more or less close concentration on this single requirement, and it has constituted most of the student's attention and application. All through the college course, this has been the dominant note in the teaching of students, and we have grown to look on it as the thing of greatest moment in the relationship between teachers and students.

Take the program of every teachers' meeting, and the topics nearly all converge in this direction and to this common end. In other words, it seems to be the essence of our interest, and for a verity it appears perfectly natural and logical that this should be so. It may be called the stuff of which dentists are made, and of which they have always been made.

But there is another side to the picture, and it is a side to which we have on various occasions called rather pointed attention. To be an expert dentist is one thing, and by the same token it is no mean achievement, but to be a cultured and well-educated gentleman may mean an altogether different and very much greater thing. It is true that the two sometimes go together, and when this is the case it may be said that the gods are propitious, but this does not invariably hold, and the point we wish to make at this time is that in the training of students in dentistry, there is just as insistent a demand for the cultivation of ethics and morality as there is for the cultivation of the highest technical skill.

The obligation placed on teachers in our professional schools is in reality a very serious matter. The intimate relationship between the public and the professional man involves the strictest obligation on the part of the professional man that he shall so deport himself at all times that the welfare of the public is conserved in every way possible. And this means not only the physical, but the mental and moral welfare as well. In other words, there is an ethical obligation that seems to us to transcend all others, and the training of dental students should be based on a constant recognition of this principle.

We have always had the feeling that when one assumed the obligation and the implied prestige of a teacher in college, he at once placed himself in such a relationship to his fellows that more was demanded of him in the way of ethical bearing and behavior than of the ordinary person, and that it was incumbent on him to show the faith that was in him by the most rigid observance of the highest ethical standards as a mere matter of example if for nothing else. The value to the student of his contact with the instructor is measured not only by the amount of knowledge that the instructor imparts to him, but also by the development of incentive in the student's mind whereby he is impelled to higher aims and nobler purpose. The influence of the instructor on a student may be of the greatest import even with very few words of admonition, and often the best teacher is the one who says the least, but who holds the student to higher aims through the subtle influence of example.

In the broadest possible sense, the thing most urgent in our college instruction is that there is a dual obligation. It is true that we need to teach dentistry, but more than that we need to teach manhood. This is something that certain of our instructors seem to forget, and it is the one thing that should be instilled in the student's mind from the time he matriculates till he graduates.

Better, after all, to be known as a highly ethical and cultured professional gentleman than merely as a skilled and brilliant operator. The ideal, of course, is embodied in the happy combination of outstanding skill, and the most transcendent and sublime observance of the principles of correct behavior and fundamental righteousness. When this combination is achieved, it may be said to embody the highest expression of what the true professional man should be.

PRACTICE IN PARAGRAPHS

This department is intended for busy readers. It aims to tell a vivid story in a few words. Items should be of a practical character, and free from padding—not more than a paragraph or two. We exact no limit, but two hundred words can tell most of these stories. Send in your ideas; they will be welcome.

Polishing Interproximal Spaces—Dull the edges of a very small bur. Wind over it a few shreds of cotton. This greatly aids in polishing interproximal spaces.—*C. C. Norris, Oshkosh, Wis.*

Relief Metal—Two or three thicknesses of the tin foil found in used roentgen-ray film packets makes good relief metal in the construction of artificial dentures.—*H. M. Flickinger, Siloam Springs, Ark.*

Suture Material—Sterilized dental floss silk makes excellent suture material. The only disadvantage is that it has to be removed. I have used it for eight years without a single case of suture infection.—*H. M. Flickinger, Siloam Springs, Ark.*

Retrieving Old Burs—Many burs are discarded when there is much usefulness still in them. Most wear on burs takes place on the tip end. By grinding off about half of the head carefully on a lathe, a new sharp cutting edge may often be obtained.—*James J. MacMillan, Carbondale, Pa.*

Perfect Coaptation of Fragments Not Essential—While a perfect reduction may be desirable, it is not absolutely necessary. In treating fractures of the jaws, excellent results have often been obtained without perfect coaptation of the fractured bone surfaces.—*James L. Zemsky, 147 Fourth Ave., New York City.*

Postdamming—A very good way to postdam for dentures is by heating the posterior edge of the baseplate of the ridge bite. Burnish with the fingers and hold until hard. Allow to extend 4 mm. beyond where it starts to turn up. Place on the hard model over carbon paper, and cut into the model until the denture base will not rock. —*C. C. Norris, Oshkosh, Wis.*

Anesthesia and Pulpless Teeth—Cavity preparation is generally better done in the absence of pain. Pain today, so easily alleviated, is a nonessential. Pain and suffering are distinctly different reactions. Suffering without pain is the worst of all. All patients do not need anesthesia in cavity preparation, because some do not suffer from pain, even if they experience it. Pain is physical; suffering is mental; both are unfortunate. The permanently pulpless and temporarily deadened are the logical teeth for carrying out accepted cavity preparation technics. Little decay is ever left in a pulpless tooth.—*Herbert Ely Williams, Red Bank, N. J.*

A Dental Stool—An ordinary kitchen stool, 26 inches high, in enamel to harmonize with the equipment can do wonders to conserve the dentist's energy and health. After a few days' trial, he can do 90 per cent of his work sitting down, facing the patient, his back erect, and not twisted and bent to one side in the old deforming behind-the-chair position that dental colleges still permit to become habitual with students through custom, thoughtlessness or imitation. The firm-legged kitchen stool gives more support and opportunity to relax than does the more expensive adjustable swiveled tilting operating stool, with which the dentist must keep both feet braced against the floor in fear of falling over.—*Alfred T. King, Chicago, Ill.*

Radical Surgery in Pyorrhea—Success of the radical surgical method of treating pyorrhea depends in a great measure on the operator's technic and his good judgment. It is essential that all incisions be made deliberately, for "hashing" of the tissues is usually followed by sloughing and formation of bad scars. An important point to be borne in mind is that removal of the structures should be limited to those affected by disease only. Another point to be remembered is that traumatization of tissues must be avoided, and therefore great care should be exercised not to damage the structures during the operation.—*James L. Zemsky, 147 Fourth Ave., New York City.*

Stop, Look and Listen—Give the patient a chance. Don't do all the talking yourself. Let the new patient tell his story first. He is going to tell it anyway. He may reveal something that might otherwise be overlooked by the dentist, who is often in such a hurry to start and proceed. Dentists are not infallible. They make mistakes—at least, some dentists do. The patients' cooperation is invaluable, provided they do not lead one astray with imaginary impressions. When a difference of opinion arises, it is best to concede to them the minor points of the discussion. Save the major points for yourself. Most persons do not enjoy the losing end. Make them lose gracefully and satisfactorily. Respect for the honest opinion of others, even though wrong, is commendable.—*Herbert Ely Williams, Red Bank, N. J.*

COUNCIL ON DENTAL THERAPEUTICS

ACCEPTED DENTAL REMEDIES

The following articles have been accepted as conforming to the rules of the Council on Dental Therapeutics of the American Dental Association. The Council wishes dentists to understand that the admission of an article does not imply a recommendation. A copy of the rules that govern the Council in the consideration of articles will be sent on request.

SAMUEL M. GORDON, *Secretary.*

Neo-Synephrin Hydrochloride. — Laevo-α-hydroxy-β-methylamino-3-hydroxy ethylbenzene hydrochloride.—The hydrochloride of the laevo isomer of a synthetically prepared derivative of phenylethylamine having the formula $C_6H_3OH.CHOHCH_2NHCH_3.HCl$.

PROPERTIES: Neo-synephrin hydrochloride occurs as white odorless nonhygroscopic crystals, possessing a bitter taste. It is readily soluble in water and alcohol. The aqueous solution is neutral to litmus paper. Neo-synephrin hydrochloride is relatively stable in alkaline solutions. It may be sterilized by boiling.

ACTIONS AND USES: Neo-synephrin hydrochloride is a vasoconstrictor. It is thus employed in combination with a local anesthetic for hypodermic injection. It is one forty-fifth as toxic as epinephrine, but only about one-sixth as active. Hence, neo-synephrin hydrochloride has only about one-eighth the toxicity of epinephrine for equivalent pressor activity.

In experiments carried out to test its effect on the length of anesthesia with procaine, it was found that the duration of anesthesia was about double that of procaine alone. Stronger solutions do not appear to increase the efficiency of vasoconstriction. (Tainter and Stockton, *Am. J. M. Sc.*, 185:382 [June] 1933.)

Neo-synephrin hydrochloride does not become colored as readily as does epinephrine. Solutions are stable without the addition of such antioxidants as sodium bisulphite.

Neo-synephrin hydrochloride is also active as a vaso-constrictor when administered orally, but these actions appear to have no immediate interest for dental use.

DOSAGE: Neo-synephrin hydrochloride for dental purposes is marketed principally in a 1 per cent solution. Three to 5 drops of the 1 per cent solution in 10 c.c. of a 2 per cent procaine-hydrochloride solution is suggested as the average dose.

Further tests of identity and purity appear in N.N.R., 1936, page 314.

Manufactured by Frederick Stearns & Company, Detroit, Mich. U. S. patent 1,680,055 (Aug. 7, 1928; expires, 1945). U. S. trademark 90,142.

Solution Neo-Synephrin Hydrochloride, 1 Per Cent: Neo-synephrin hydrochloride, 1 per cent; sodium benzoate, 0.1 per cent, and sodium chloride, 0.8 per cent, in distilled water.

DENTIFRICES*

Craig-Martin Tooth Paste.—Composition: Each 100 gm. is said to contain calcium carbonate (Snow-Top Standard Drug), 35.28 gm.; tricalcium phosphate (Victor), 4.07 gm.; glycerite of starch, 32.13 gm.; magnesium hydroxide, 3.70 gm.; powdered soap, 1.10 gm.; gum tragacanth, 0.11 gm.; flavoring oil (oil of peppermint, oil of spearmint, menthol crystals and anise oil), 0.84 gm. and distilled water, 22.77 gm.

ABRASIVENESS: The abrasiveness determined by the method described under Snow Top Calcium Carbonate (J.A.D.A., 23:490 [March] 1936) causes a loss of not more than 1 mg.

Manufactured by the Comfort Manufacturing Co., Chicago, Ill. No U. S. patent. U. S. trademark.

*A.D.R. 1935, p. 91.

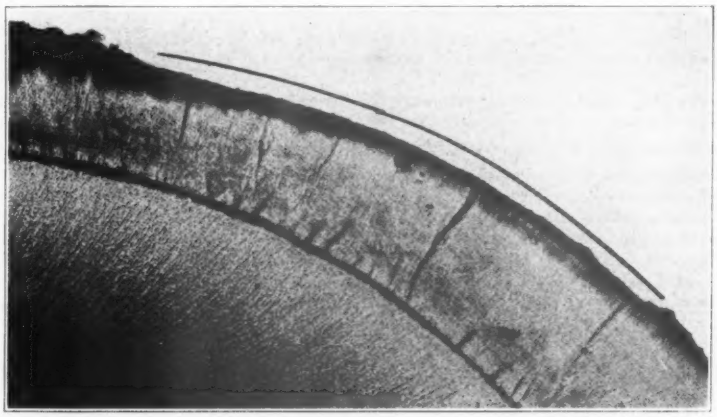
TAXI—NOT ADMISSIBLE TO A.D.R.

The following report has been authorized for publication by the Council.

SAMUEL M. GORDON, *Secretary.*

Taxi, put out by the Holland Specialty Company, Peoria, Ill., was the subject of a report by the Research Council of the New York Academy of Dentistry in 1928. The New York investigators reported that Taxi contained 4 per cent of hydrochloric acid. These investigators showed, by histologic methods, the destruction of enamel to be expected from the use of Taxi, as shown in the accompanying cross-section.

In a counter reply to the report of the New York Academy, the manufacturers, in the face of these facts, maintained that the use of Taxi is not injurious to the enamel. They insisted that their directions, "Apply to the teeth, wait a few seconds and use brush wheel" permit neutralization before any injurious action has taken place. They also stated, ". . . the profession demands Taxi and we are supplying the demand."



Specimen subjected to action of "Fluid 1" (Taxi) for three minutes.

Five years later, Taxi is still being advertised to dentists in some dental journals whose criteria for the acceptance of advertising has not yet reached the standards set by THE JOURNAL. An advertisement in *Dental Survey* for November, 1935, states: "Get ALL the STAIN and get it in 10 minutes' time! . . . TAXI Liquid positively will not injure either enamel or gum tissues; and it makes no claims toward being anything other than what it is: a cleanser. . . . TAXI Liquid sells for One Dollar a bottle, on a money-back guarantee of satisfaction."

In view of the inquiries received from dentists concerning this preparation, and the advertising in dental journals after the exposure of its composition and harmfulness, Taxi was again subjected to examination in the A.D.A. Bureau of Chemistry. The report that follows indicates that the composition is approximately the same, 3.9 gm. of hydrochloric acid per hundred centimeters, as against the 4 per cent reported by the New York investigators.

Crowns of teeth, the roots of which were protected with paraffin, were subjected to the action of Taxi for periods as short as five seconds, as measured by the stop watch, and the liquid tested for any dissolved calcium and phosphorus. Qualitative tests revealed

that enamel immersed in Taxi for periods as short as five seconds dissolved the enamel. Fifteen seconds' treatment of enamel with Taxi produced marked decomposition. This, of course, is what would be expected from the action of hydrochloric acid on enamel, regardless of the name under which it is sold.

In view of the confirmation of the results obtained by the New York investigators, the Council declares Taxi inadmissible to Accepted Dental Remedies.

The Council also desires to point out that the use of liquids containing hydrochloric acid for removing concretions or stains from teeth is in the interest of neither the dentist nor the patient. Its use is unreservedly condemned. The Council also desires to record its amazement at the acceptance of an advertisement for such a product by dental journals. Such products certainly would not be accepted for advertising according to the standards of THE JOURNAL. The report of the chemist follows:

TAXI

Three original packages of Taxi (Holland Specialty Co., Peoria, Ill.), price, $1 each, were purchased on the open market for examination.

The following appeared on the label:

This preparation will remove instantly, without the aid of pumice stone, all green, black, vegetable and nicotine stains from the teeth, *positively without injury to the enamel or gum tissue.*[1]

You can clean up the foulest mouth in 10 minutes with TAXI. Sold on a positive guarantee to give satisfaction or money refunded.

The following "NEW uses for TAXI" appear on a subsidiary label:

For removing Mercurochrome and Iodine stains from fingers and white porcelain tops of cabinets and tables.

For removing the calcium deposit in the glasses and cuspidors.

For cleaning artificial dentures.

When mixed with a little powdered pumice will polish the mercury from gold.

It is used in place of alcohol for dehydrating abutments and cavities in gold work. Removes the mucous and the vegetable matter from abutments and cavities.

Mix a few drops with alloy and mercury get amalgamation almost immediately removes all dross.

Taxi will remove Nitrate of Silver stains from teeth surface or structure also from lips, fingers, etc.

Each package contained 170 c.c. of a red odorless liquid that had a sharp, acid taste and possessed an acid reaction to litmus. It had a specific gravity of 1.0238 (25C/25C).

Qualitative reactions indicated the presence of hydrochloric acid. No other ingredients were found qualitatively.

Quantitative determinations yielded the following:

Residue 100 C.	0.09 gm./100 c.c.
Ash 600 C.	0.04 gm./100 c.c.
Acidity (as HCl)	3.85 gm./100 c.c.
HCl (by titration with silver)	3.94 gm./100 c.c.

Action on Teeth: Taxi was the subject of a report by the Research Council of the New York Academy of Dentistry. (J. D. Res., 7:477 [Dec.] 1927.) According to these findings, Taxi, marked as "Fluid 1," was found to have an acidity of 4 per cent in terms of hydrochloric acid. Teeth treated for one minute with Taxi and sectioned showed an etching of the enamel. In a discussion of the findings of the investigators of the New York Academy of Dentistry appears a discussion by the proprietors of Taxi. They attempt to minimize the findings of the New York Academy of Dentistry investigators by raising the objection that the experiments of the investigators did not follow the directions, namely, "Apply to the teeth, wait a few seconds and use brush wheel."

1. Italics not in original.

Accordingly, extracted teeth were subjected to the action of Taxi for periods as low as five seconds, as measured by a stop watch. Fifteen seconds yielded decided results for calcium and phosphorus. The amount of calcium and phosphorus dissolved in five seconds appears to be significant when judged by the volumes of calcium oxalate and ammonium phosphomolybdate precipitates obtained.

It is therefore concluded that even five seconds' treatment of teeth with Taxi dissolves enamel. These tests confirm the results of the New York investigators.

WETHERILL PROPHYLAXIS STAIN REMOVER—INADMISSIBLE TO A.D.R.

The Council has authorized publication of the following report.

SAMUEL M. GORDON, *Secretary.*

Dentists are informed by the manufacturers of Wetherill Prophylaxis Stain Remover that it contains no hydrochloric acid and no ammonium floride (sic). It is stated to be effective in "removing stains WITHOUT harm to teeth." A 6-ounce bottle sells for 75 cents. The absence of the above-mentioned ingredients is further impressed on the purchaser by repetition in a letter.

Stain removers are not new. The common ingredient of most of them is hydrochloric acid. After the exposé of several of them by the Research Council of the New York Academy of Dentistry (J. D. Res., 7:477, 1927) and the Council (Tartaroff, J.A.D.A., 15:2167 [Nov.] 1928; Klex, J.A.D.A., 22:1397 [Aug.] 1935), citric acid as an ingredient of these stain removers makes its appearance. This was noted in the report on Tartaroff in THE JOURNAL (22:315 [Feb.] 1935). Tartaroff was found to be approximately a 4.5 per cent solution of citric acid. Its deleterious effect on extracted teeth was shown. In connection with that report, the Council stated: "The Council desires to point out that the use of such products for whitening the teeth is contrary to public interest. . . ."

Wetherill Prophylaxis Stain Remover has been found, by examination in the A.D.A. Bureau of Chemistry, to be an approximately 10 per cent solution of citric acid. It will dissolve enamel, as shown in the chemist's report.

Wetherill Prophylaxis Stain Remover should indicate to dentists another trick of certain proprietary medicine promoters. The prospective purchaser is told what the product does not contain, but no reference is made on the label or in other advertising as to what it *does* contain. The dentist should be interested in what the product contains, more than in what it does not contain.

The chemist's report follows:

WETHERILL PROPHYLAXIS STAIN REMOVER

One original package of Wetherill Prophylaxis Stain Remover (Wetherill Products Co., Akron, Ohio), price 75 cents, was purchased on the open market.

A statement of composition does not appear on the label.

The package contained 180 c.c. of a clear red liquid, with an odor suggestive of root beer. It was strongly acid to litmus. It had a specific gravity of 1.039 at 20 C.

Qualitative tests indicated the presence of citric acid.

Quantitative determination yielded the following:

Residue 100 C.	10.6 gm. per 100 c.c.
Titratable acidity (As citric acid, U.S.P.)	9.7 gm. per 100 c.c.

No other tests were made.

From the foregoing, it was concluded that Wetherill Prophylaxis Stain Remover is essentially a 10 per cent solution of citric acid.

BUREAU OF PUBLIC RELATIONS

EDUCATION OF THE SCHOOL CHILD FOR DENTAL HEALTH*

By J. M. WISAN, D.D.S., Elizabeth, N. J.

IF it is true that the improvement of dental conditions depends on our ability to guide children in dental health practices, the topic "Education of the School Child for Dental Health" merits critical analysis and meticulous investigation.

A few fundamental definitions are offered for a cooperative understanding of terms.

Dental health will be referred to as that condition of the organism in which mouth tissues provide optimal function and comfort and contribute to the mental, physical and emotional welfare. The phrase "dental health practices" will refer to those practices utilized by the health and education professions and by individuals to promote and maintain mouth health.

Education for dental health is the sum of all experiences which favorably affect habits, attitudes and knowledge relating to the dental health of individuals and of communities.

"Health education is a general term conveying a wide field of human experience. It includes more than mere instruction in health and should be used to designate the broader field."[1]

The consideration of the rôle to be played by the official agency, the dental society, the dentist, the school and the home in educating the school child for dental health is based on selected premises and analysis of existing programs.

PREMISES

1. The American public is not sufficiently interested in dental health of children to bring about a substantial improvement in dental conditions.[2]

2. Intentions, plans and resolutions of persons without intrinsic, impulsive powers[3] and lacking external compulsion are not generally conducive to changes in health practices. If it is assumed that human beings are not, for the most part, influenced as to behavior by reason,[4] emotional appeals should not be overlooked.[5]

3. Psychologic studies indicate that the initial conditioning of children is more

*Read before the Section on Children's Dentistry and Oral Hygiene at the Seventy-Eighth Annual Session of the American Dental Association, San Francisco, Calif., July 16, 1936.

1. Williams, J. F., and Shaw, Fannie B.: Methods and Materials of Health Education, New York: Thomas Nelson and Sons, 1935, pp. 2-3.

2. Rogers, J. F.: School Health Activities in 1930, Washington, D. C.: The United States Department of the Interior, May, 1931, Pamphlet No. 21, pp. 9-10; 22-23; 27, 30.

3. Thorndyke, E. L.: Psychology of Wants, Interests and Attitudes, New York: D. Appleton-Century Company, 1935, pp. 1-16.

4. Jastrow, Joseph: Wish and Wisdom, New York: D. Appleton-Century Company, 1935, pp. 230-246.

5. Pareto, Vilfredo: Mind and Society, New York: Harcourt Brace and Company, 1935, Vol. 1, pp. 75-170. Gambard, Mark: Biology and Human Behavior, New York: Tomorrow Publishers, 1936, pp. 7-9. Mitchell, W. C.: What Veblin Taught, New York: Viking Press, 1936, pp. 27-36.

effective than are attempts to recondition them.[6]

4. The results of dental health education programs depend on the ability to motivate administrators of health and education programs, nurses, physicians, dentists,[7] hygienists and teachers, as well as children and parents, for more widespread dental health practices among children.

ANALYSIS OF EXISTING PROGRAMS

A survey of the health education field to appraise dental health education programs for children revealed the following:

1. Many educators are not aware of the extent of dental disease among children[8] and the significance of its neglect during childhood. Although administrators of health education programs are confused regarding the relative value of the various dental health practices, the assistance of dental societies is not sought. As a result, too much stress is being placed on teaching methods[9] and too little stress on teacher interest in and teacher knowledge of dental conditions.

2. Many dentists participating in public health programs are untrained in technics of education.[10]

3. Accompanying the emphasis on optimal nutrition as a long term objective is frequently found failure to recognize the difficulty in obtaining changes in dietary practices in uncontrolled situations and the failure to appreciate the indispensability of preventive dental treatment.

4. Many communities do not take full advantage of the services of dental hygienists.

5. Unwillingness of communities to pay for dental health education programs and unwillingness of individuals to pay[11] for preventive dentistry[12] deleteriously influence dental health.

If this estimate portrays, with any degree of accuracy, the status of dental health education programs in most American commonwealths, educational programs designed to arouse interest in dental health are urgently necessary for child welfare.

Who is to do the motivating?

Official agencies, dental societies, practicing dentists, hygienists, nurses, schools and the homes may initiate dental health practices for children.

THE ROLE OF THE OFFICIAL AGENCY

Where official state or community departments include a supervisor or director of dental hygiene (the term "dental hygiene director" may apply to any dentist in charge of a community dental health program), the person holding such position may motivate health professions, health and welfare organizations[13] and individuals to participate in the dental program.

6. Burnham, W. H.: Wholesome Personality, New York: D. Appleton-Century, 1934, pp. 658-660.

7. Report on Public Health Policies of Georgia Dental Association, May, 1935.

8. Caldwell, O. W.; Skinner, C. E., and Tietz, J. W.: Biological Foundations of Education, New York: Ginn and Company, 1931, p. 449.

9. Turner, C. E.: Principles of Health Education, New York: D. C. Heath and Company, 1932, pp. 256-257.

10. Ruef, Dorothy: Health Education in Senior High Schools, New York: Bureau of Publications, Teachers College Columbia University, 1934, p. 90.

11. Laird, Donald: What Makes People Buy? New York: McGraw-Hill Book Company, Inc., 1936, pp. 15-34. Thorndyke, E. L.: Presidential Address to the American Association for the Advancement of Science, New York Times, Dec. 31, 1935.

12. Social Year Book 1935, Third issue, New York: Russell Sage Foundation, 1935, p. 260.

13. Hiscock, I. V.: Community Health Organization, New York: The Commonwealth Fund, 1932, pp. 29-30.

TABLE 1.—DATA FROM U. S. PUBLIC HEALTH SERVICE (AGES 12-14)*

State	A Community Showing Best Dental Conditions	Z Community Showing Worst Dental Conditions	Percentage of Children Needing Treatment		Percentage of Children Needing Extraction of Permanent Teeth		Percentage of Children Receiving Treatment Prior to Examination		Percentage of Children Having Had Permanent Teeth Filled Prior to Examination		Percentage of Children Having Had Permanent Teeth Extracted Prior to Examination	
			A	Z	A	Z	A	Z	A	Z	A	Z
Maryland	Garrett County		86		28		47		31		22	
		Charles County		100		6		24		0		0
Massachusetts	Plymouth		71		17		96		78		17	
		Worcester		97		36		95		47		49
Michigan	Oakland County		57		3		49		37		10	
		Bay City		95		22		59		27		27
Minnesota	Rochester		48		7		92		77		12	
		Clay County		97		20		64		54		19
New Jersey	Westfield		55		8		85		81		16	
		Camden		96†		20†		41†		18†		19†

*Public Health Bulletin 226. †Negro Children.

		Camden		95		40		64		27		38

*Public Health Bulletin 226. †Negro Children.

		Camden		95		40		64		27		38
Tennessee	Lincoln County		60		9		16		7		6	
		Nashville		99†		12†		11†		2†		7†
		Nashville		94		7		45		21		10
California	Palo Alto		32		6		97		71		5	
		Modesto		93		7		70		47		11
Florida	Tampa		64†		12†		5†		5†		1†	
		Tampa		93		25		43		13		20
		Gainesville		83		4		44		26		5
Indiana	Gary		53†		5†		99†		26†		13†	
	Gary		69		19		90		41		12	
		East Chicago		98		28		57		8		15
Iowa	O'Brien County		68		3		71		40		13	
		Allamakee		97		23		66		51		20
Maine	Franklin County		62		11		74		61		13	
		South Portland		95		29		80		51		37

*Public Health Bulletin 226. †Negro Children.

The dental hygiene director is reasonably certain of cooperation if he is careful to give publicity and credit to the efforts of his collaborators. The assistance of the dental society is of inestimable value to him, for a health education program that fails to obtain the cooperation of the local dentists will fail at a most vital point. Because dental treatment in a very great majority of cases is rendered in private offices, it is important that the content of public health education material be substantiated by private practitioners. Such coordination will be obtained more easily if the endorsement of dental health policies by the dental societies be made a fundamental objective. Another advantage of the collaboration of official agencies and dental societies will be found in the distribution of official health education material through the medium of private offices.

THE ROLE OF THE DENTAL SOCIETY

Where official dental hygiene departments have not been established, it is the exception rather than the rule for school or health administrators to assume effective leadership in dental health education programs. Under such conditions, it would seem that leadership will need to come from the organized dental profession, who may well make its first objective the appointment of a state, county or city director of dental hygiene.

Leaders of the dental profession believe that the improvement of public health through dental measures will increase the prestige and standing of the dental profession. When this opinion is adopted by the rank and file of the dental profession, we shall find more dental societies promulgating intensive dental health education programs.

In New Jersey, we have found the activities of the Council on Mouth Hygiene of the New Jersey State Dental Society guiding dental health education programs of benefit to the public and to the profession.[14] A few items of the New Jersey Program will be cited to demonstrate the theories presented in this discussion.

With the realization that a dental health education program, in order to be successful, must establish new dental health concepts among the whole population, an advisory committee has been formed to include administrators of health organizations and educational institutions. Individual members of the advisory committee conduct specific activities; whereas, the opinion of the whole committee is sought in designating general policies. Thus is obtained authoritative opinions of educational technics, public policy and lay points of view. Moreover, members of the advisory committee frequently state that during the committee meetings they obtain valuable information, which helps them carry on dental health activities within their departments and communities.

Furthermore, every effort is made to consider the individual interests of the members of the advisory committee as well as benefits that might accrue to the organizations that they represent.[15] This may seem like furthering a doctrine of selfishness. Surely, one does not need to be an expert in psychology to appreciate the fact that one is more apt to obtain cooperation when interested in the welfare of those whose assistance is sought.

The educational activities of the New Jersey Group presuppose that the public health, the public welfare is paramount. Precautions are taken to avoid the im-

14. Wisan, J. M.: New Jersey State Plan of Dental Health Education, D. Cosmos, 77: 1080 (Nov.) 1935.

15. Holt, E. B.: Whimsical Condition of Social Psychology and of Mankind, American Philosophy Today and Tomorrow, New York: Lee Furman, Inc., 1935, p. 153.

pression that the dental program is conducted to spread propaganda in the interests of the dental profession. This is more difficult to accomplish than is first realized. It is by no means easy for members of any profession to avert personal prejudices and interests. The advisory committee, as described above, has proved indispensable in conveying the sincerity of our purpose to our public.

Various kinds of material, bibliographies and programs for classroom teachers, nurses and hygienists, are published. Adult programs, such as self-study projects for parents, panel discussions and forums, are arranged. Through the *New Jersey State Dental Journal,* dentists are informed of dental health projects and presented with scientific information for the improvement of dental health.

It has been the experience of most health educators that the scissors, paste and rubber stamp methods do not obtain the results that activities arising spon-

TABLE 2.—DENTAL SURVEY OF SCHOOL CHILDREN (6-14 YEARS)*

State	Percentage of Children Needing Treatment	Percentage of Children Needing Extraction of Permanent Teeth	Percentage of Children Having Had Permanent Teeth Filled	Percentage of Children Having Had Permanent Teeth Extracted
Tennessee	91.7	4.0	7.6	3.9
New Jersey	88.8	16.6	22.7	16.1
Indiana	87.5	9.6	16.1	7.4
Minnesota	82.5	10.2	29.6	1.0
South Dakota	81.9	7.1	16.1	7.9
Average	86.5	9.5	18.4	7.2
Pennsylvania	93.9	27.3	22.3	17.6
Maryland	93.9	10.0	13.8	6.9
Wisconsin	93.0	10.8	33.1	8.8
Georgia	92.8	4.1	33.2	3.9
Utah	91.1	8.6	27.4	19.7
Nebraska	90.4	6.5	21.4	7.7
North Dakota	90.2	10.6	18.4	10.2
Oklahoma	89.3	3.2	9.0	4.1
Michigan	89.2	9.9	27.9	8.9
Massachusetts	88.7	20.7	33.0	17.8
Colorado	87.9	2.3	20.3	4.1
Louisiana	87.1	9.8	6.0	5.3
Arizona	86.9	3.1	11.9	3.1
Iowa	86.5	4.9	26.3	6.6
Virginia	86.4	7.4	14.5	4.1
Ohio	86.3	10.1	23.3	11.4
Oregon	85.9	5.8	3.4	6.2
Maine	85.7	13.3	24.5	15.4
Florida	84.9	4.8	33.4	4.3
California	75.4	2.1	31.9	4.2
Average	88.2	8.7	21.7	8.5

*Public Health Bulletin 226.

taneously within the community do. Too often, borrowed programs do not fit in with the needs and conditions of the community using the second-hand material. It is like quoting statistics of dental conditions in a far distant city to prove the need of dental programs in a particular city. The lack of personal appeal is responsible for the resulting lack of zeal.

Those who have participated in the preparation of dental health education material are more likely to aid in its dissemination, for they will take a personal interest in the work. Then, too, the preparation of the material is educational in itself.

The dental society may present opportunities to its members to become better informed in public health and health education technics. Courses and lectures by experts in these subjects may be arranged for dentists interested in public programs.

The American Dental Association may pronounce authoritative dental health principles in accordance with our present-day knowledge. Such principles may be applied by local dental societies and official agencies. Perhaps we, the representatives of the states, should urge the American Dental Association to accept this responsibility. Let us avoid confusion as far as it is possible and, above all, prevent persons with unscientific ideas and propensities from misguiding educators.

THE ROLE OF THE DENTIST

Individual dentists have been able to contribute to the health of their patients, for every experience in the dental office has educative implications. But private dentists need educational material that will enable them to give dental health information to their patients without interfering with operating time. It would seem that materials furnished by dental societies, health departments, schools and foundations would be most convenient. It is hoped that the use of commercial material, not endorsed by authoritative opinion, will be discouraged. Unless he has an opportunity to carry on scientific research, the dentist should be willing to subordinate his opinion when he is not in agreement with authorities and present information to his patients which is in accordance with authoritative present-day knowledge.

The dentist has the opportunity of educating children for dental health by:

1. Encouraging patients to adopt an optimal diet.
2. Instructing patients to brush teeth properly.
3. Encouraging the beginning of dental treatment at the age of 2 and arranging for dental treatment throughout life at intervals determined by individual susceptibility.
4. Examining teeth skilfully, thoroughly and methodically.
5. Eliminating pits and fissures in deciduous and permanent teeth before decay begins.
6. Protecting the normal arrangement of deciduous and permanent teeth.
7. Treating carious teeth as soon as discovered.
8. Inserting and completing fillings in such manner as to minimize the possibility of recurrence of decay.
9. Giving skilful prophylactic service.
10. Replacing missing teeth according to contemporary knowledge of orthodontia and dental prosthesis.
11. Preventing and eradicating dental infections.
12. Cooperating with physicians for systemic health.
13. Creating a friendly relationship between child patients and himself so as to encourage the child to meet dental needs and problems.

The personality of the dentist, the atmosphere of his office, the method and

skill he uses in treating his child patients all have educational implications that outweigh even the information he presents to his patient, important as is factual information.

Many dentists need to learn that emotions enter into the educational picture. It is obvious that there is a tendency on the part of dentists to place too great value on knowledge and too little on guidance for dental health practices.

With this in mind, dentists would be wise to become more familiar with such subjects as educational psychology, general psychology and mental hygiene, which will enable them to study patients individually and employ the measures necessary for each patient.

THE ROLE OF THE SCHOOL

Undoubtedly, the school exerts a profound influence on the attitudes and practices of children. Results obtained by many communities[16] where well-directed dental health programs have been promulgated, indicate that a more nearly universal application of sound health education methods in the schools will improve dental health practices.

Health education methods in many schools are based on the theory that children are not interested in dental health for dental health itself,[17] but are interested in dental health if it is of value in the attainment of their desires. This point of view seems to be a sound basis on which to build a dental health education program. At the same time, we need to be aware of the fact that children, in adopting dental health practices, sacrifice the pleasures of eating some attractive and tasty foods and undergo experiences in the dental office that are far from pleasant. Dental health practices, in other words, involve conflicts within the personality. As the individual will determine the end-result of this conflict, health educators are stressing technics that translate knowledge into attitudes and attitudes into practices through individual interests. H. Shirley Dwyer has aptly said: "The child plus knowledge plus doing equals dental health."

The following methods may be used to advantage by the school personnel in promoting dental health among school children:

1. Collaboration with dental societies in organizing and preparing health education programs, assuring authentic factual knowledge in dental items.

2. Mouth mirror and explorer examinations of children's teeth during the first week of each semester to determine the status of dental conditions upon which to base a dental health service and education program. Only dentists and hygienists should inspect children's teeth.

3. Cooperation with parents in correction of dental defects, including a careful system of follow-up of dental corrections.

4. Evaluation of results of dental health education program at the end of each semester.

5. Application of guidance forms of instruction to the dental problem; for example, class discussions[18] and teaching units[19] and experimental exhibits.[20] Orig-

16. Committee on Community Dental Service of the New York Tuberculosis Health Association: Health Dentistry for Community, Chicago: University of Chicago Press, 1935, pp. 25-30. Health Dentistry for the Community, Chicago: University of Chicago Press, 1935, p. 29. Fitzgerald, Harriet: Enjoying Trips to Dentist, Hygeia 13 (Feb.) 1935.

17. Hussey, Marguerite: Principles of Teaching Health, Interpretations of Physical Education (Edited by Jay B. Nash), Vol. 4, New York: A. S. Barnes and Company, 1933, pp. 189-196.

18. Footnote 1, pp. 255-258.

19. Wynne, J. P.: Learning-Teaching Unit, Farmville Herald, 1934, pp. 7-15.

20. Hoan, D. W.: City Government, New York: Harcourt Brace and Company, 1936, p. 10.

inality and ingenuity are two requisites in using these methods, for their purpose is defeated unless they are developed from the specific needs and interests of the pupils.

6. Cooperation with nutritionists and managers of school lunchrooms and cafeterias.

7. Emphasis on preventive treatment rather than emergency palliative treatments in dental service programs.

8. Extension courses in dental health education for teachers, nurses and social workers.[21]

Frequently, dentists attempting to interest school administrators in dental conditions are confronted with the criticism that the dental problem is but one item in the whole health picture. While it is true that oral health is but a part of the whole health scheme, it cannot be denied that a physical defect that is present in almost every child and one that is so apt to be responsible for systemic disease presents a challenge to our civilization. A dualistic approach is needed in solving the dental problem. The total welfare of children is to be paramount, indeed, but there are specific problems in the health program that need the specialized knowledge of dentists. As Milton J. Rosenau writes,[22] "Each kind of physical defect needs special study."

It would seem that if both general and specific needs are to be met by the dental program, administrators will not meet with success unless they obtain the collaboration of health personnel including dentists. By and large, educators have been too complacent concerning dental health, failing to take advantage of the environment and the home in the educational process.[23]

THE ROLE OF THE HOME

When we discuss the significance of the home in meeting dental problems, social, economic, biologic and psychologic problems are involved. A dental health education program that is prepared without minutely studying all phases of family life in the community is apt to be merely a passing breeze which wafts its way in and out.

Dental health educators would do well to look for lasting results in provision by parents of optimal diets for the children and assurance for them of the benefits of preventive dentistry through the preschool, school and adolescent periods. It may be expected that properly educated children will develop into adults that will continue the dental health practices taught them even to the point of, in time, teaching their children to have an interest in dental health.

The home has the first opportunity of conditioning the child to dental health practices and preventing the necessity of the longer and more unsatisfactory process of reconditioning him when he is older. The dentist will then bear the responsibility of maintaining a pleasant relationship between himself and the child. Herein lies the crux of the dental health problem.

The field of adult education is undergoing marked changes and improvements,[24] offering unlimited opportunities to foster dental health practices.

21. Wisan, J. M.: Dental Health Education —An Extension Course, Child Health Bulletin, 11:26-28 (Jan.) 1935.

22. Rosenau, M. J.: Preventive Medicine and Hygiene, Ed. 6, New York: D. Appleton-Century Company, 1935, p. 1732.

23. Butler, N. M.: Schools and Community, Teachers College Record, 37:578 (April) 1936.

24. Gruenberg, B. C.: Science and Public Mind, New York: McGraw-Hill Book Company, Inc., 1935, pp. 185-189. Studebaker, J. W.: Liberalism and Adult Civic Education, Ann. Am. Acad. Polit. & Soc. Sc., 1935, p. 68. Quiett, G. C., and Casey, R. D.: Principles of Publicity, New York: D. Appleton-Century Company.

Undoubtedly, the private practitioner, both the physician and the dentist, as well as the hygienist and the nurse, plays a leading rôle in developing the attitude of the home in regard to dental health. For this reason, it is suggested that future adult education programs include their participation.

CONCLUSION

If the premises and analyses presented are tenable, educational principles concerned with establishing dental health practices are to be utilized. The official agency, supervised by a director of dental hygiene, collaborating with dental societies and other health and welfare organizations, is listed as most effective to direct the efforts of the schools, the dentists and the homes to meet dental needs. In the absence of such an arrangement, the dental society is urged to accept leadership in dental health programs.

The Report of the White House Conference on Child Health included the statement: "Dental disease is preventable, it is our problem to prevent it."[25] It would seem that the problem of preventing dental disease is primarily an educational one, not merely the education of children or parents, not merely provision for certain courses in the dental schools, but a changed dental health concept. Dental conditions may reach the ideal we seek if communal, familial and individual concepts are improved so that dental health practices will be more widely adopted. Health professions and educational institutions must collaborate to attain such an objective. Above all, inspired and intelligent leadership is needed in every state and every local community.

Let us remember that education is a slow process. A leader in one community, a hygienist in another, a director in one state, a chairman of a local or national committee, in carrying out his duties is helping this gradual process of dental health guidance.

It is true that we meet indifference, hindrance and obstacles that may seem insurmountable, but how can we be other than optimistic as we read the reports of successful dental programs throughout this nation and other nations?

At the time that we are carrying on individual programs, we may not appreciate their far-reaching effects, but sooner or later results will become evident. Ideas, knowledge, objectives, persistence and enthusiasm—all are needed. May we return to our duties with more of those requisites.

Dental health is obtainable. It is our duty to provide it.

Columns marked "A" in Table 1 contain figures for communities showing the best dental conditions in the respective states. Columns marked "Z" contain figures for communities showing the worst dental conditions in the respective states. The tabulation was obtained from the United States Public Health survey in order to estimate dental conditions in communities of the various states.

It seems to be agreed by most observers that, owing to the different technics used and to the human elements that enter into the various phases of dental examinations, actual comparisons are not to be made from the data. This tabulation has been included merely to indicate the point stressed that the American public is not sufficiently interested in dental health to bring about substantial improvement in dental conditions.

When it is realized that even in the communities of high economic level, such as Westfield, N. J., Plymouth, Mass., and Gary, Ind., 16 per cent, 17 per cent

25. White House Conference on Child Health and Protection: School Health Program, III. C., New York: Century Company, 1932, p. 106.

and 13 per cent, respectively, of the children between the ages of 12 and 14 have had permanent teeth extracted, it must be admitted that, on the whole, dental conditions are deplorable.

The average for the five states, Tennessee, New Jersey, Indiana, Minnesota and South Dakota, is given separately in Table 2 because more than 25 per cent of the estimated child population was examined in those five states. Even in the state showing the best record, namely, California, 75 per cent of the children require dental treatment. The averages of 18.4 per cent and 21.7 per cent of children having had permanent teeth filled is a point that needs to be called to the attention of health educators.

DISCUSSION

Richard C. Leonard, Baltimore, Md.: Dr. Wisan has made discussion of his paper a comparatively easy task by his prefacing the body of his treatise with four main premises: 1. Public disinterest. 2. Methods of motivation. 3. Time element of motivation. 4. Necessity for greater comprehension of objectives and means of obtaining them on the part of health workers in general. He phrases what I have termed disinterest in the following words: "The American public is not sufficiently interested in dental health." In other words, he attributes disinterest to the lay public. Does not Dr. Wisan's subsequent report of a comparatively successful program of dental health education contradict this accusation of disinterest? Rather, is it not a case of lack of knowledge or of positively held misinformation that accounts for the seeming apathy of the public? I believe these are the real facts of the case. And to continue on this amended premise, should not the blame for the status of dental health in lay minds be placed with us of the profession rather than with the public? We are possessed of factual knowledge regarding the importance of and the means of having dental health. If we serve as mere appliers of that portion of our knowledge which deals with correction of malconditions that have come about through lay lack of knowledge, if we fail as purveyors of facts that will combat ignorance and misinformation, we, the dental profession, are to blame for the continued apathy of our uninformed fellow citizens. As an example of lay misinformation regarding dental health, none is more outstanding than the fallacious belief that exfoliation of the temporary teeth eliminates any need of operative care of them. If this fallacy did not originate with the members of the dental profession (that knew better) or even if the profession has not actively fostered it, they have been derelict in their duty in not stamping out such beliefs. If continued belief of such misinformation by the lay public is designated as "lack of interest," I demur and say the fault is not theirs, but ours. As a matter of fact, at least based upon personal experience, while there is by no means a 100 per cent interest in dental health, there is a greater response from lay people to facts relative to mouth hygiene than to many other phases of child health. There is a tangibility to our work that seems to strike a responsive note. This, too, in face of the obvious fact that some of the other health projects deal far more directly with problems of actual life conservation. For instance, one would feel that 100 per cent of the laity would be interested in—would fight for—immunization against diphtheria. But, many times, a surprising apathy is encountered. And, strangely enough, numerous reports have come to me of situations wherein an immunization campaign has failed and where a dental health program has then been attempted, and the success of the latter has resulted in success in a second immunization program. As to the second premise, covering motivation, or methods to be employed in educational processes, Dr. Wisan, perhaps unintentionally, gives indirect voice to the old axiom that health instruction should have started with our grandparents. If it had done so, in time the will to maintain health might have become an intrinsic impulse. Lacking this background of generations, we must utilize every possible means

of educating or motivating people toward better mouth health, not hoping immediately to rectify all the present ills, but gradually to spread our doctrine so that, perhaps, our grandchildren will be born with an almost, at least, inherent tendency for the optimum in mouth structure and function. Dr. Wisan's third and fourth premises are closely related to one another. The third states the advisability of initial conditioning of children as contrasted to attempted reconditioning. The fourth calls for motivating of health workers, teachers, children and parents as regards dental health practices. Both terms "conditioning" and "motivating" may be defined simply, even if from varying angles, as "education." That initial education or conditioning of children is advisable may be taken for granted except so far as it outlaws efforts toward education ("reconditioning," "motivating," call it what you will) of older persons, particularly those older people who may be looked to to furnish what Dr. Wisan calls "external compulsion." I do not mean to recommend adult education at the expense of child education. Both should be attempted. To omit adult education from a program spells prolongation of effort until generation after generation of children, educated in childhood, have reached maturity still cognizant of the facts taught them in youth. Walter H. Brown, in a paper "Adult Health Education,"[26] read before a health association at Denver, June 9, 1932, quoted H. G. Wells as saying that "the world must choose between education and catastrophe" and Joseph Kinmont Hart ("Adult Education") as follows, "It is not the education of the child that can save the world from destruction; it is the education of adults. It is the adult who must be released from his narrow mindedness, his prejudices, his outworn customs and his obsolete habits." Here, most succinctly, I think, is expressed the necessity Dr. Wisan emphasizes in his fourth premise. One criticism of Dr. Wisan's fourth premise may be unjustified. Perhaps his listing of those who must be educated was made without regard to the relative importance of the parts they play. At any rate, he listed dentists and teachers far down the line. In my opinion, they should head the list. The rôle of dentists is obvious. The part of teachers may be only second to that of members of our profession. Few dentists are trained in pedagogy. But if we can educate teachers who are so trained, we will have available for dissemination of our knowledge a force who are capable of using varying methods of approach in child education and who, too, have the advantage of day in and day out contact with children. Dr. Wisan has omitted one factor that affects dental health education. He has omitted it and not ignored it because it cannot be ignored. That factor is the cost of such a program. Dr. Wisan has described the essentials for an "optimum" dental health education program. With some possible extensions, ramifications or modifications to take care of the varying situations met in different sections of our country, his outline might well be accepted as a far-flung goal toward which we may strive. But practicality demands consideration of costs. I am sure Dr. Wisan has ideas about this factor. He must have or his plan is purely ethereal. My own outlook permits me to recognize the splendor of the plan; my own experiences make me qualify hopes of its fulfilment by questioning the feasibility of financing it. Two years ago, at St. Paul, I gave "education" as the primary function of any health department. As I am in a health department, my belief in furtherance of any or all proper efforts toward dental health education may be taken for granted. But neither that personal attitude nor recognition of the impossibility of stopping educational processes blinds me to possible difficulties that our efforts may create. For instance, to hypothecate the complete country-wide adoption of Dr. Wisan's plan and the gradual but eventual education of the public, who is going to furnish them, at least the indigent and low-wage level group, with the services they will have been taught to desire? Other than in-

26. Brown, W. H.: Am. J. Pub. Health, 22:1061 (Oct.) 1932.

sisting that in the answer organized dentistry maintain its politically free autonomy, I have no reply to my question. But our dental health educationists and our dental economists are going to have to get together.

TOOTH CUSTOMS OF THE AUSTRALIAN ABORIGINES*

Doctor: Thank you, Mr._____, and good morning everybody.

Announcer: Pardon me, Doctor. I wonder if, before you give your talk on "Diet and Dentistry," I might ask you a personal question. Perhaps it's not exactly personal, I should say its professional. It's about my nephew. Perhaps I shouldn't ask you, shouldn't impose on our friendship, but I've listened to you for so long that I have begun to take a close interest in my nephew's teeth, and I want some practical advice.

Doctor: Why certainly, _____. I'm glad to help you any way I can. What's the trouble?

Announcer: Well, my brother's boy—he's 14 now, and a good-looking, well-built kid—thinks he's going to make a wow of a football player. But his upper teeth—I mean the ones at the angles of his mouth—are a sight. "Buck" teeth, I think you call them. Instead of growing down even with the others, they have come in above them and they stick out at the angles of his mouth like miniature tusks. He's becoming so conscious of them that he's actually afraid to smile.

Doctor: Yes, that's an all-too-common occurrence, _____, and is probably caused by the fact that he lost some of his baby teeth too soon.

Announcer: Well, I don't know what caused it, but I do know what it is causing, and I want to know how to correct it.

Doctor: Without seeing the boy, I hesitate to recommend any treatment; but from what you tell me, I suspect his dental arches should be widened and those teeth brought into their proper position.

Announcer: That's what I told my sister-in-law you'd say; but a friend of hers, a neighbor, told her that straightening the boy's teeth would be a long-drawn-out process and advised her to have them pulled out.

Doctor: Your sister-in-law didn't take her neighbor's advice, did she?

Announcer: No. I told her not to do anything until I had asked your opinion.

Doctor: My opinion, _____, is that the boy's mother should take him to her family dentist at once. If the condition is what I think it is from your description, his teeth should be straightened. In fact, in all probability, appliances should have been placed on them several years ago. However, even at his age, the condition can be corrected. If your family dentist does not straighten teeth, he will refer the parent to an orthodontist, a specialist in that field. But don't let anyone pull out the good healthy teeth of a 14-year-old boy. That is not being done in America. It sounds more like a tooth custom of the Australian aborigines.

Announcer: Do the natives of Australia pull out all of their children's teeth?

Doctor: No, not all of them. Only certain ones; and they don't pull them; they knock them out.

Announcer: Knock them out? How and why?

*Radio talk.

Doctor: Among the native Australians, the act of removing teeth is very old, and it is, as a rule, practiced by many of the tribes as a religious rite, or to celebrate the transition of a youth from boyhood to manhood. Imagine yourself, if you can, transformed from a staid, modern American radio official to a suntanned native of central Australia. The scene is in the Australian bush.

Night's star-studded canopy melts all objects into a soft whole without detail. Somewhere a drum beats. [Sound effect, tomtom.] Deep in the forest, another answers. [Pause for distant tomtom.] Seated in the darkness in a great circle are many people come to witness the last phase of the initiatory rites of the tribe. They are silent—silent with an almost audible sense of expectancy. From out of the darkness comes a wrinkled old man. The circle opens to let him through. He squats by a pile of brush arranged to make a fire. Out of an old bag fashioned of animal skin, he takes a slab of wood and a long spindle-shaped stick. The stick twirls between the oppositely moving palms of his two supple hands — faster — faster — faster. Smoke comes. Fire comes. The miracle of recreating the life-giving sun heat has come to pass. The pile of faggots is ignited. Flames leap up. Faces appear out of the darkness. They assume individuality, but no expression. Only expectation. Flattened hands beat upon taut drumheads. Again the answer from the forest. This time closer. Ever closer.

A procession comes. Guided by the older men in charge of the rites come twelve adolescent boys. They are nude, yet covered with gray ashes which, clinging to their hair and attached to their eyebrows and lashes, create a queer spectacle-like effect. They march around the fire, the utter silence broken only by the drumbeats, now amplified by "Him Who Drummed in the Darkness."

They lie down, radiating from the fire. The witch doctor kneels over the first lad from behind. He draws back his upper lip and places a blunt wedge of hardwood against a tooth. Beats on the wedge with a mallet. Slow, methodical blows. The tooth loosens. Is lifted out for all to see. Is then tossed far off into the darkness. The witch doctor goes on to the next initiate. His first patient shudders slightly. Great beads of perspiration mingled with dirt and ashes trickle down his face to mix with the blood-stained froth at the juncture of his lips; but what matters it? *He is a Man*—he has passed his last test. And while his heart pounds for joy with it all, he hears the methodical, maddening, slow beating of the medicine man's mallet on the tooth of the next neophyte.[1] [Tomtom fades out slowly.]

Announcer: Wait a minute, Doctor, wait a minute. You don't really mean to tell me that those benighted natives actually mutilate their children's mouths?

Doctor: That's what returned travelers and explorers from that country tell us.

Announcer: How terribly brutal! How uncivilized and cruel! To think that, in this day and age, there are people on this globe practicing customs of that kind.

Doctor: It makes you wonder, doesn't it, _____? It makes me wonder also. I wonder whether the heathen custom which causes children to lose their teeth by violence is much more barbaric than the thoughtless habit of many American parents which allows many of our children to lose their teeth by decay and inattention.

Announcer: By Jove, Doctor, you're right. We should be ashamed of ourselves. After all, the natives are following a custom handed down through the ages. They don't know any better. We do.

Doctor: That's right, _____. By the way, I see that our time is up, but I really

1. Stein, Harold: Savage Beauty, J.A.D.A., 20:1217 (July) 1933.

feel that your question has brought out some points that were far more interesting to the radio audience than the talk I originally planned to give.

THE PRAYER TO THE RAIN GOD*

Announcer: By the way, Doctor, that description you gave us last Saturday of the mutilation of teeth by the Australians has been running through my mind all week. I've come to the conclusion that if I had to belong to that branch of the human race, I'd rather be a female than a male.

Doctor: Why, ——?

Announcer: Somehow or other that "tooth knocking out" idea doesn't appeal to me. I suppose all adolescent boys must undergo the ordeal in order to prove themselves worthy of entering man's estate. Even if only certain ones were elected, it would be my luck to draw the blackball. Apparently, the little women get a break down there.

Doctor: That's because I didn't tell you the whole story last week, ——. The fact of the matter is, custom demands that the aboriginal girls as well as the boys be subjected, for one reason or another, to some form of mutilation. It is not always their teeth that are mutilated. It may be decreed by the powers that be that the victims lose a finger or toe, or perhaps have the body, chest or legs scarified. Travelers tell us that the custom followed by certain tribes of subjecting their young to mutilation is part of their religious rites, especially those rites associated with sun worship and rain-making. As you know, water is extremely scarce during certain seasons of the year in Central Australia. In order to gain favor in the eyes of the rain gods and obtain an ample annual supply of moisture, the superstitious natives stage elaborate rain-making ceremonies. Very often during these ceremonies, several of the tribe's sturdiest children are chosen as sacrificial offerings. These sacrifices usually consist of some type of very painful mutilation from which the victims emerge scarred for life. Frequently, they knock out several of the front teeth so that the dark empty interior of their mouths may resemble a dark rain cloud, or the sky deprived of the sun. The girls more often than the boys are victims of such sacrifices.

Announcer: That sounds frightfully barbaric, but interesting. I wonder what the connection is between knocking out teeth and the making of rain. Just an old Australian custom, I suppose.

Doctor: I suppose. However, among the aborigines, it is a very solemn and sacred custom. Few white men have ever witnessed the ceremony. In fact, among certain tribes, etiquet demands that the men of the tribe shall not witness the removal of the teeth of one of the opposite sex.

Announcer: By Jove, Doctor, just because it is taboo, I'd like to see a rain-making ceremony.

Doctor: Australia is a long way off, ——, 'way down under, you know, and even though we have the inclination, few of us have the time or the money to visit those primitive people. We must be content to take our travel from textbooks and treatises.

Announcer: That method is safer and is time-saving, but certainly much less exciting and thrilling. I suppose that re-

*Radio talk.

turned travelers have written a great deal on the subject.

Doctor: Not a great deal, ——. Not so much as you would think. By piecing together several short statements, we can paint the following picture:

It is late afternoon. The sun, a great red ball of metallic fire, hurls the last of its vitriolic rays upon the dry, parched veldt. The long eerie shadows of early evening creep like slithering, sleek snakes, silently across the sandy wastes. Since early morning, the villagers have been preparing for the evening orgy. The men and boys have piled brushwood head high in the village circle. The women and girls have toiled ceaselessly at baking cakes and meats and other fine foods for the festival. Even the smaller children have hewn wood and drawn vessels of water. The wives of the tribesmen are in charge; this is the rain rite of the females. Four of the loveliest maidens, the loveliest the chieftain's own daughter, are chosen for this season's victims. At dawn, they were clothed in fine raiment and lodged in the guest hut of the village.

All day they have been cared for and guarded. And now, in the shadows of twilight, the withered old women surround them; and, trailed by the rest of the females, 'mid chanting and weird incantations [sound effect], they wend their way out of the village into the bush and wastelands, down to the edge of the river. Only the females are present. The males dare not witness the ritual. As the procession nears the end of the journey, the singing is silenced abruptly. [Sound stops abruptly.] They shuffle in absolute silence, though the stifling stillness is broken by the soft steady pad of their foot beats. At the brink of the river, they are halted, and the ranks of the women are parted. Slowly, the innocent victims enter the mud-laden water. Deeper and deeper, they enter, until they are submerged to the waistline. Weaving in rhythmical fashion, they bend like reeds in the west wind. Slowly, their weaving increases, 'til their bodies are wet from the splashing. Shaping their palms in cup fashion, they drink long draughts of the water. Part of the liquid is squirted toward every point of the compass. Finally, their heads and their hair dress are immersed in the warm yellow river.

In the meantime, a few of the oldsters have lighted a fire in the clearing. In the coals of the fire, they have shaped and sharpened and hardened wood weapons. The sun, now sunk in slumberous stupor, has belted the bush with black velvet. At last, the weapons are finished, and mallots are fashioned from faggots. Now, at a pre-arranged signal [sound effect], the silence is broken by screechings. Each oldster outscreams the other, each yell is more vibrant and piercing, until it would seem that the heavens would be rent with the reverberations, and the sun aroused from his slumber. Chanting and dancing and crying, the victims are dragged from the waters. Roughly, they are dragged to the firelight with a fury maddened by frenzy. Each of the victims is pinioned and lashed to the trunk of a gum tree. The chief of the oldsters, the withered and weathered, places the fire-hardened weapon on the upper front teeth of a victim, and, 'mid the screams and the chanting, 'mid the shouts and the prayers to the rain god, the teeth of the innocent maiden are brutally battered and broken. As they drop from the mouth [sound effect softened], they are salvaged, and when the victim recovers, she hurls them far into the river, far into the mud-laden current. As they sink 'neath the yellow-brown waters, the women increase their chanting, increase their shrill supplications to the merciful, mysterious rain god for a moist and bountiful season. [Sound effect heightened and stopped abruptly.]

Thus, each innocent maiden gives part of herself as an offering, suffering the tribal tortures to win the good will of the rain god.

After the torture is over, after the ordeal is finished, all return to the village, where the men have lighted the bush fires. All through the night, there is feasting and singing and beating of tomtoms. [Sound effect, tomtoms.] Finally, the shrill cries and the laughter waken the sun from his slumbers. The natives kneel with bowed heads as he rises. [Sound effect fades away.] They receive his bland benediction and, as he climbs in the heavens, they sink in utter exhaustion into sleep of the righteous.

Thereafter, for the length of their lifetime, the mutilated mouths of the maidens are proof of their courageous offering to appease the wrath of the rain god.

Announcer: I suppose, Doctor, that the girls who make this sacrifice are held in great esteem by the other members of their tribe?

Doctor: Undoubtedly. Not only are they held in great esteem, but they are considered more beautiful than their less fortunate sisters. Rest assured that they do not lack suitors.

Announcer: Isn't that interesting, Doctor? I mean, not only is your story interesting, but the psychology also of the natives is interesting. It is just the reverse of ours. Apparently, down there, the natives consider the loss of front teeth an asset to beauty. Here, girls of marriageable age do everything they can to preserve their front teeth to enhance their good looks.

Doctor: Right you are, _____. Many women, young and old, and, for that matter, many men, think of dentistry from an esthetic standpoint only. As long as the front teeth look passable, they feel comfortable.

The esthetic value of good teeth should not be underestimated, but teeth have an even greater value—a health value. Many pockets of infection are sometimes hidden under good looking teeth. Don't be satisfied with the outward appearance of your teeth alone, _____. Have them x-rayed every two years, at least; especially, if you have any devitalized teeth in your mouth. And another bit of advice: keep your back teeth or molars in as good condition as your front ones. From the standpoint of mastication, they are the most important.

Announcer: Thank you, Doctor, I do take good care of my teeth. I learned my lesson many years ago. The American business world won't tolerate an unclean, unkempt mouth, and neither will one's body. You can say what you please, but we have traveled a long way from the ways of the aborigines.

Thank you for the interesting account of the rain-making ceremonies of the Australian natives. I'm sure our listeners appreciated it.[1]

Mouth Hygiene in Mississippi

The Mississippi mouth hygiene program is built around three age groups: preschool, school and adult, for whom the types of service are inspection, instruction and cleaning. The greatest attention has been given to the school group, but increasing emphasis in the past few years is being placed on the children under-school age. Contact with them is made chiefly through preschool conferences where the service of a dental hygienist has become a factor in increasing the attendance.

The adult group embraces expectant mothers, midwives, members of home demonstration clubs, teachers in the field and in training, and members of parent-teacher and civic groups. While instruction is the major service here, inspection and

1. Material for much of this article was taken from Kanner, L. P.: Folklore of the Teeth, D. Cosmos, 1926.

cleaning are given when possible as a demonstration to that end.

Emphasizing the value of adequate dental service for adults, the Mississippi State Board of Health now requires of all employes a complete roentgen-ray examination of the mouth at two-year intervals, supplementing the yearly physical examination.

During 1935-1936, 450 midwife clubs in Mississippi chose a definite project: "Clean Mouths." Reports coming from counties in that state having only thirty-one negro dentists are most surprising and encouraging. The complete report promises to demonstrate results of health education and its practical application.

With the assistance of Maternal and Child Hygiene Funds under the Social Security Act, the Mississippi State Board of Health increased the number of itinerant dental hygienists, equipped them adequately, and gave one a nine months' scholarship. As many as twelve dental hygiene workers were employed at one time, including three additional white hygienists and two colored hygienists. The four county workers and the eight itinerants worked a total of 107 months, the equivalent of nine full-time workers throughout the year.

The permanence of the mouth hygiene program is absolutely dependent on the interest, understanding and skill of the dentists. If a mouth hygiene program is undertaken in a community, it is because the dentists want it there. If it is successful, the success is theirs.

JAPANESE DENTAL HEALTH PRIZE WINNER

In Japan every year, semigovernmental committee for the health examination of the primary school children, aged 12, is established. And the child who possesses the healthiest physique, mental condition and has the best attainments at school is awarded the first prize. For the year 1935, Tsutomu Aramaki was the winner. He had the healthiest body, mental condition and the other requirements necessary for the choice. He had the most perfect and healthy teeth for his age, of all the children examined. Incidentally his father is a graduate of the Tokyo Dental College and is a practicing dentist. His most meticulous care of the teeth of his son has been re-

Tsutomu Aramaki

warded eminently in the condition of Tsutomu. The father had devoted the utmost attention, carrying his five years' plan, on the teeth of his son as well as his general health with the result that Tsutomu

has been selected as the first prize child.

The Japan Dental Association in its propaganda for the Dental Decay Prevention Day, 1936, has printed and distributed pamphlets and posters describing the care and methods employed by Dr. Aramaki, whose efforts were amply rewarded. The slogan for the year 1936 was "Strong Teeth for Strong Body." A million copies were distributed of propaganda materials.

The picture in the poster sent to you is that of Tsutomu.—T. Okumura.

THE SUMMER ROUND-UP OF THE CHILDREN: 1935 ANNUAL REPORT*

The Summer Round-Up of the children continued during the past year to prove its worth as a stimulus to greater interest in health, not only for children entering school for the first time, but also for children of all ages. There was a gratifying increase in the number of units engaged in the project, in the number of children examined and in the number of children receiving medical and dental care. As compared with 6,431 Congress units registered last year, this year 7,020 registered. Last year, 92,268 children received the Round-Up examination; this year 95,467 children were examined. Last year, 15,100 children received medical care; this year, 15,820 children received medical care, and there was a slight increase in the number receiving dental care, 13,716 children last year as compared with 13,754 this year. There was also a gratifying increase in the number of children receiving protective treatments against diphtheria and smallpox and those receiving tuberculin tests.

Total number of Congress units registering for the Summer Round-Up			7,020
States represented		47 and Alaska	
Communities represented		2,809	
City groups	3,908		
Town groups	1,634		
Rural groups	1,478		
Total number of units carrying through the Summer Round-Up			3,831
States represented		47	
Communities represented		1,599	
City groups	2,410		
Town groups	810		
Rural groups	611		
Number of these units which met national campaign requirements			3,403
Number of units that held the spring examination and fall check-up, but corrected no defects			452
Number of units that held only the spring examination			235
Number of units that failed to carry through the work or were unable to send definite information regarding progress made			207
Tabulation of reports shows:			
Number of children entering school (kindergarten or first grade) Fall of 1935 in districts where Round-Up was carried on			187,453
Number of these children receiving Round-Up examination			95,467
Number of children examined by family physician			20,430
Number of parents or guardians present at the examination			72,127

*Lillian R. Smith, chairman.

Number of children examined who needed medical care	41,192†
Number of these children receiving medical care	15,820
Number of children examined who needed dental care	34,952
Number of these children receiving dental care	13,754
Number of children receiving vaccination against smallpox	36,325
Number of children receiving immunization against diphtheria	29,233
Number of children receiving inoculation for typhoid	429
Number of children receiving tuberculin test	3,381

AMERICAN DENTAL ASSOCIATION ON C.B.S. NORTHWEST NETWORK

Beginning Tuesday morning, September 1, 8:45 to 9:00, and continuing each Tuesday until September 22, the American Dental Association presented, in cooperation with the Columbia Broadcasting System, a series of twelve-minute broadcasts entitled: Dental Customs of Primitive People. Beginning September 29, these broadcasts will be given at 11:15-11:30 Eastern Standard Time.

The Columbia network is making these talks available through the following stations: WOC, Davenport, Iowa; KRMT, Des Moines, Iowa; KFAB, Lincoln and Omaha, Nebr.; WISN, Milwaukee, Wis.; WCCO, Minneapolis and St. Paul, Minn.; WMBD, Peoria, Ill.; KSCJ, Sioux City, Iowa; WNAX, Yankton, S. D.

The subjects and dates for the first ten talks in the series are:

September 1, Tooth Customs of the Australian Aborigines
September 8, The Prayer to the Rain God
September 15, Curious Dental Customs of the Dyaks
September 22, Dyak Dentistry
September 29, Dutch East Indian Dental Customs
October 6, Javanese Dentistry
October 13, Dental Customs of the Negritos.
October 20, Dental Adornments of the Native Filipino.
October 27, Dental Customs of the Moros.
November 3, Dental Decorations of the Bisayan Islanders.

All of the material in this new series has been approved by the Committee on Dental Health Education of the American Dental Association and the United Public Health Service.

Please cooperate by calling these dental educational broadcasts to the attention of your patients and friends. Have them send in their comments to the broadcasting station over which they receive them.

The radio talks on pages 1990-1994 are the first two in this series. Others will be published from time to time as space permits.

---

†This figure does not include figures for Virginia for children needing medical and dental care or receiving medical and dental care (no figures given on local report blanks). Need for medical care does not include lack of protection against smallpox, diphtheria or other communicable diseases.

DENTAL ECONOMICS

STATE EDUCATION AND STATE MEDICINE

THE state educates us, why should it not heal us? It protects us against invasion, why not against disease? So runs one of the most frequent arguments for state medicine.

Perhaps the state system of education failed in its effort to teach logic to those who reason thus. Analogy is proverbially a dangerous foundation for a logical premise. Disease and education differ widely even though many exposed to both fail to get either.

For the special comparison, differences are greater than resemblances. Every one needs all the education he can get, especially if he is to be of value to a democratic state. In childhood and youth we all need much the same sort of education and even as adults there are so many who wish to learn the same things that books, lectures, classes and radio can be used effectively for mass educational treatment. It is possible to make fairly accurate diagnoses of ignorance and of progress through educational treatment by mass examinations, although even in education there are some doubts as to the accuracy and efficiency of such mass methods.

Ignorance does not come on suddenly and create an emergency demand for education. The need for education varies slightly with times and conditions. The positive benefits of education are not confined to the individual. Society obtains a direct return for its investment in the education of its members.

Health and ignorance are alike in only a few features and within those limits the state is already active. The value of that activity depends largely on how closely it is limited to the fields for which it is fitted. Whatever can be done for the people as a whole, the state can usually do with fair success. Where individuals must be distinguished and given widely different and suitable treatment, the mass action of government is seldom successful.

The state can establish quarantine to protect the whole people against the invasion of disease, collect and tabulate vital statistics of the whole population, assist in health education, urge widespread general immunization and rally the forces to meet the mass attacks of epidemics. Within those limits and such others as have the same qualities, the medical profession has always aided and encouraged state activity.

When individuals are to be aided in recovery from illness, the analogy with education becomes a contrast. It is seldom that two persons need exactly the same treatment. Medical service is seldom as helpful when given to groups or classes as when administered to individuals. The degree of disease and progress of recovery vary widely, are hard to measure and cannot be standardized in grades.

Medical service does not fit into time tables. Its value depends largely on a personal relation between two individuals —the sick person and his physician. It must be given in widely varying intervals to each individual, and its value depends in a high degree on the way it is suited to each personal situation.

The reasoning that would have medicine follow the educational pattern is further weakened by an increasing apprehen-

sion that standardization in education has not been wholly successful. Forcing teachers and pupils into a common mold is held to be destructive of both individual and social values, to injure those of exceptional ability and thereby to deprive the nation of greatly needed intelligent, independent leadership.

Political influence and pressure groups have worked much harm to education, although it is much better suited than medical service to resist or endure such influences. It is charged that supervision by lay boards, ignorant of pedagogic methods, has hindered professional progress and tended to cripple the freedom of thought and investigation that is of fundamental importance in education. Again such influences would be much more destructive in the medical field.

In spite of the fact that education is freely offered by the state to every one and that over 26,000,000 pupils were in elementary and high schools in 1931-1932, there were at the same time over 2,700,000 in private and parochial schools. In other words, 10 per cent of the population refused to accept the free standardized system offered and preferred to pay for the kind of education they considered more suitable to their individual desires.

The total cost of public day schools amounted to over $2,160,000,000 and the expenditures in universities and colleges was over $600,000,000 more. It was impossible even with these great expenditures and the enormous extent of standardization to provide employment for those who had been accepted as teachers, so that in 1930 there were nearly 12,000 teachers, in the words of the census, "out of a job, able to work and looking for a job." The effect of the depression was widespread, causing reduction in educational services and failure to pay those teachers who still remained at their work.

To the extent that education does resemble medical service, it seems to have suffered under state administration. Only where the contrast is greatest has it been successful. If a comparison is to be made, it would seem to be a warning rather than as an example.—*J.A.M.A.*, Aug. 22, 1936.

DIVISION OF ORAL HYGIENE OF THE NORTH CAROLINA STATE BOARD OF HEALTH

NORTH CAROLINA DENTAL SOCIETY ECONOMIC ORGANIZATION PLAN

The North Carolina Dental Society is divided into five districts. Each district has an economic committee of four members, one of which is chairman. The state deputy of the American Dental Association economic committee is chairman of the state committee. This organization plan permits all economic information to pass rapidly from the Central Office through the district member and state deputy to the five state component societies. Conversely, it enables the five state committees to keep in close touch with all economic activities within their district and report them through their state deputy and district member to the Central Office.

NORTH CAROLINA DENTAL EDUCATIONAL PLAN

E. C. Branch, state director of dental hygiene of North Carolina and advisory member to the Children's Bureau, U. S. Department of Labor, describes

the North Carolina dental health educational plan in detail. Essentially, it is as follows:

The Division of Oral Hygiene of the State Board of Health is directing its activities to the field of prevention by conducting an educational program in the schools of the state.

The six essential factors in arriving at and carrying on the present plan for the teaching of oral hygiene in the schools of the state are as follows:

1. North Carolina has a dentist, recommended by the North Carolina Dental Society and appointed by the governor, as a member of the state board of health.

2. North Carolina is the only state having a law requiring that a dentist be a member of each county board of health.

3. North Carolina is one of the few states that has in its state board of health a division of oral hygiene on an equality with other divisions and directed by a licensed dentist who devotes his full time to the activity.

4. The division of oral hygiene of the state board of health has, in addition to the director, a staff of twenty licensed dentists.

5. The dental member of the state board of health makes an annual report to the North Carolina Dental Society.

6. The director of the division of oral hygiene makes an annual report of the activity in his department to the North Carolina Dental Society.

The director of the division is reponsible for the activities of the division. He supervises and directs the dentists in the field, teaches oral hygiene in the teacher training institutions of the state, lectures to civic clubs and meets with appropriating bodies to secure outside funds to finance the program.

Oral hygiene programs were conducted in thirty-eight counties and three city units during the school year 1935-1936. The 2,077 lectures which were given were attended by 111,376 children, and dental corrections were made for 45,943 indigent children. Dentists are equipped with portable outfits.

The division of oral hygiene of the state board of health receives from the Children's Bureau approximately $30,000.

The division of oral hygiene receives no aid from the United States Public Health Service, since the division of oral hygiene is already set up and their appropriations are for the purpose of setting up, in the states, divisions of oral health.

The financing of the division of oral hygiene is from the state board of health and appropriations by counties, cities, towns, civic clubs, parent-teacher's organizations, women's clubs and individuals.

The arrangement for oral hygiene programs in the counties of the state is that the county pays one-half of the expense and the state board of health pays the other half.

A minimum appropriation of $900 is required from a county with a population of from 35,000 to 50,000.

Appropriations from counties the past school year were $25,000; from the state board of health, $21,000, and from the Children's Bureau, $30,000.

An outstanding achievement for the year 1935-1936 is the arranging for a course of public health dentistry to be taught in the division of public health of the University of North Carolina. This course opened on May 25 and is being attended by sixteen white dentists on the staff. The four colored dentists are taking their course at the Atlanta-Southern Dental College. This, so far as we know, is the first and only school to prepare dentists for public health work.

The staff, both white and colored, were sent to the Forsyth Dental Infirmary for a special course in 1935.

The dentists of North Carolina believe that the activities of the division of oral hygiene, both educational and corrective, controlled and guided by organized dentistry, are the answer to the socio-economic problem for the prevention of dental infection, particularly in the children of the state.

THE MCDOWELL COUNTY DENTAL CLINIC (MAINTAINED BY LEVY), WELCH, W. VA.

EARLY in 1919, a number of the large taxpayers of McDowell County, West Virginia, met to draft a bill authorizing the county court to establish and maintain a free dental clinic for the resident children under the age of 16. The bill passed both houses Jan. 24, 1919, with but one dissenting vote and was approved by the governor, Feb. 6, 1919. Work began at different points in the county Sept. 15, 1919.

This clinic is the only one in the world to be established by a vote of the people at a special election after the legislature passed an enabling act authorizing that a vote be taken. This levy has, as a result of yearly dental care given the McDowell County children, been reduced 50 per cent. The dental clinic cares for the children of only this county.

The larger schools have a fully equipped dental office, and, in the smaller ones, a portable outfit is set up and the work is done in the school buildings.

Stereopticon views and lectures, toothbrush drills and inspections teach children how to keep in condition after the extraction, filling and cleaning of their teeth. In the school and P.T.A. meetings, lectures are given and slides are used to instruct parents and children regarding the care of the teeth and what foods to eat and the importance of diet.

Every child in McDowell County is using a toothbrush as a result of the establishment of the clinic. Children's diseases have been materially reduced, school attendance has been improved and the capacity to study and the ability to learn has been increased. It is impressed on the child that he does not accept the services of the school dentist as charity, but rather that it is a part of the school.

It was found that children of the wealthier class need dental attention just as much as do the children of the poor. Rich and poor alike used to be sent to the dentist. Now he comes to them as a part of the public school system and they accept this service just as they accept the services of their teacher. All dentists are carefully selected, not only for their high standing in the profession, but also for especial fitness to handle small children.

If the clinic were to be closed now, the good that it has accomplished in promoting the health and improving the mentality of babies and children during the last sixteen years would be passed on as a heritage to succeeding generations.

McDowell County has fifty-two P.T.A.'s, and the recently organized county council has aroused fresh interest in the work and, of the fifty-two, thirty-eight have affiliated themselves with the council. There have been, to date, twenty-five Summer Round-Ups of preschool age children, with an average of thirty-five examined at each conference. Many defects are being corrected daily in all parts of the county by the family physician, and P.T.A. and other civic or-

ganizations. The Round-Up groups are much smaller and have noticeably better results.

The director of the McDowell County Dental Clinic will, on request and the assurance that there will be a sufficient number of children to justify the measure, send a dentist and portable equipment to any community, as is done during the school term. Otherwise, the work is done in the clinic, which remains open throughout the year. This same procedure is followed with the colored P.T.A.'s and their Round-Ups, a colored dentist doing the work.

In the long run, the amount of money spent for a dental clinic will be partly repaid to the school fund by children making their grades earlier and not being retarded or failing to be promoted.

The children of McDowell County received all needed dental services beginning with preschool age and continuing to the age of 16.

The percentage of decay among the resident McDowell County children has decreased about 70 per cent. In the smaller communities of the Pocahontas Coal Fields, we have a floating population that comes from other counties and states that do not have free dental care, and this reduces the percentage to about 40.

During the school year, there are employed: four full-time dentists (white), three half-time dentists (white), three

TABLE 1.—TOTAL NUMBER OF DENTAL OPERATIONS PERFORMED BY THE MCDOWELL COUNTY DENTAL CLINIC DURING THE FISCAL YEAR ENDING JUNE 30, 1936*

	White	Colored	Total
Patients treated	9,253	4,964	14,217
Temporary fillings	2,551	699	3,250
Permanent fillings	4,805	1,628	6,433
Permanent teeth extracted	475	103	578
Temporary teeth extracted	3,333	1,962	5,295
Cleanings	8,281	4,964	13,245
Treatments	2,571	348	2,919
Local anesthetics	4,370	1,671	6,041
X-ray examinations	459		459
Orthodontia	1		1
Porcelain crowns	9		9
Gold inlays	3		3
Partial dentures	7		7
Total operations	26,885	11,375	38,240

*The appropriation for the previous year was $15,750. (The appropriation varies each year according to the tax levy.)

TABLE 2.—FIVE YEAR HISTORY OF ACTIVITIES OF CLINIC

Year	Patients Treated	Operations	Cost Per Year
1930–1931	17,336	78,206	$37,063
1931–1932	18,212	63,486	25,512
1932–1933	14,585	53,659	15,776
1933–1934	12,899	31,128	15,194
1934–1935	15,526	54,571	19,078
1935–1936	14,217	38,240	15,750

full-time dentists (colored), one half-time dentist, and one hygienist.

All dentists are graduates, are licensed and are required to be members of the local and state dental societies and of the American Dental Association. These dentists are in good health. They are paid good salaries, in keeping with the standards of the dental profession.

The clinic remains open during the summer vacation period with two dentists working full-time.

THE PUBLIC SCHOOL HEALTH SERVICE OF A KANSAS TOWN

By THOMAS A. MAYHEW, D.D.S., Wichita, Kan.

A MODEST but comprehensive dental health activity has been maintained in the school system of the city of Wichita, Kan., for a number of years. This dental educational program is a component part of a department known as the "Department of Health and Physical Education, Wichita Public Schools." A distinctive branch of the school system, it is authorized and financed by a very public spirited school board. H. C. Holmes, dentist, is a member of the school board. Under the general supervision of the school superintendent, this department is headed by a chief supervisor, who is in charge of all departmental activities, his staff consisting of one full-time physician, four part-time dentists, who are on duty four mornings a week as inspectors, eight full-time nurses, one teacher of lip reading for hard of hearing children, and thirty male and female full-time physical instructors. In addition, each elementary school has one teacher, who is assigned to supervise physical education in that school. All must be graduates and professionally ethical. Nearly a million dollars has been invested in large gymnasiums, swimming pools and health rooms and their equipment.

In addition, we have a sunshine room, a room where the totally deaf are taught to speak and several special rooms for subnormal pupils.

The dentists examine each child from the kindergarten up to and including the high-schools, at least once a year. They make a written report to the supervisor once a week. Three dentists examine the white children and a colored dentist looks after the three schools for colored children. Several preschool clinics are held every spring, so that children who expect to enter school in the fall may be on record when they enter. Each time the dentist's visit is due, the principal is notified and instructed to furnish several pupils as helpers in the health room. They run errands, look after children and take care of the portable sterilizers. In each school room of every elementary school, a loose leaf record book is kept, containing the physical and scholastic data on each child. On his record are placed the results of the dental examination, and on the child's promotion into other grades, the record goes with him. In the junior high and senior high schools, a new card is made, similar to the other, and this is carried in a file in the health room in the charge of the nurse assigned to that school. When the child is reexamined by the visiting dentist, a small card is given the child, to be carried home and showing the results of the dental ex-

amination and what corrections are necessary, and advising that the family dentist be consulted at once.

When time permits, each classroom is visited and health talks are given on the care of the mouth. Indigents are sent to the newly established free clinic maintained by the county. This work was formally under the school system, and during the time it was a part of the school health program, the number of children with defective teeth had fallen as low as 51 per cent. Since that time, it has gone up and down, the school year of 1935-1936, showing 64 per cent with defective teeth. Of the 18,341 school-age children inspected, 11,786 had defective mouth conditions. Of this number, 7,131 had decayed permanent teeth, 3,960 had decayed temporary teeth only and 2,577 needed orthodontic care.

The dental profession cooperates heartily in this work, giving their moral support, and very often giving time to emergency cases. When a child is absent from school, a nurse goes to the home to check up on the case, but does not remain. The visit is merely for the purpose of ascertaining the reason for the absence and to give advice in case of infectious or contagious disease. The full-time physician of this department maintains an office near the department supervisor where he receives emergency cases, but he spends most of his time visiting the schools and giving physical examinations.

When a child drops out of school or moves to another school within the city, the record of his physical, dental, audiometer reading and scholastic records is retained in a permanent file at the last school he attended or is sent with him in case he changes to another school in the system.

We regard this as a very comprehensive system and believe that our records, while not the best perhaps, compare very favorably with those of other cities.

Fourth National Bank Building.

MATERNAL AND CHILD HEALTH DENTAL PROGRAM OF THE STATE OF INDIANA

SCOPE OF WORK

In the organization of the program of the Indiana State Bureau of Maternal and Child Health, dentistry has been given its rightful place in the initial plans. This program provides a means of educating the people as to the need for dental attention and caring for the dental needs of the children of that class of people who, in their present financial circumstances, are unable to provide the dental attention necessary to the health of their children.

METHODS

The program provides for two full-time dental officers in the Maternal and Child Health Bureau. One, the dental director, is in charge of the educational phase of the work. This officer's time is to be spent in cooperating with the public schools in bringing to the attention of all school children the importance and necessity of adequate dental care. This educational program is to be carried on with the cooperation of the dental practitioners in the towns and cities in which the program is being given. Mary H. Westfall is the director and has been serving in this capacity since May 1, 1936.

The other dental officer is Robert L. Peden, who was appointed from the 1936

graduating class of the Indiana Dental School, and serves in the capacity of an operator. He is in charge of a mobile trailer type of dental office, fully equipped, which is moved from one community to another. During its visit to any given community, prophylaxis, extraction, amalgam and cement restorative service is given without charge to children who are eligible under the regulations, which are definitely set up. In every instance, the educational program is to precede the appearance of the mobile unit into a community.

ELIGIBILITY OF PATIENTS

Only those children will be accepted as patients who have been referred by the agencies listed below in the county in which the mobile unit is located at the time. These children must be between the ages of 3 and 10, inclusive, and must be adjudged by the local referring agencies as being from families whose financial conditions would make it otherwise impossible for the children to receive dental attention.

REFERRING AGENCIES

The referring agencies are: (1) the local relief agency; (2) the local dentists who are members of the Indiana State Dental Association, and (3) a public health nurse.

INAUGURATION OF PROGRAM

Greene and Owen counties have been selected for the first dental demonstration area. In order to make a just choice, the statistics of the various counties of the state were studied to assist in determining not only the field which would be presented for demonstration, but also the financial conditions of the citizens of this particular section. The Indiana State Planning Bureau and the Bureau of Vital Statistics furnished the necessary statistical information.

PALAMA SETTLEMENT'S DENTAL CLINIC FOR SCHOOL CHILDREN, HONOLULU, HAWAIIAN ISLANDS*

Fifteen years ago, in a small house on Hotel Street, Honolulu, Mrs. Helen Strong Carter started a dental infirmary for children.

More children are being cared for, and at less expense per child, for the sixth consecutive year. Extractions of permanent teeth have been reduced from 2.6 per child in 1929 to 0.6 per child in 1935.

The total number of children treated is 31,799. During 1935, 9,318 children made 34,622 visits for 76,350 operations. The number of fillings in permanent teeth decreased 536 over the previous year, even though 873 more children were treated as the result of educational efforts.

The mouth hygiene treatments numbered 12,661, certain children requiring more than one treatment. There were 19.3 operations per completed case in 1929 as compared with 6.17 operations in 1935.

There were 8.6 visits per completed case in 1929, 2.8 in 1935. In 1929, there were 26.5 extractions of permanent teeth, while, in 1935, there were only 6.07.

The operating staff consists of nine

*Extracts taken from the annual report, 1935, by E. H. Bruening.

dentists working six and one-half hours per day. M. I. Connor, D.D.S., is the dental director. Philip S. Platt, Ph.D., is director of Palama Settlement.

There were 17,227 school children of the thirty Honolulu schools, 9,318, or 54 per cent, being eligible for treatment in the clinic.

A fee of 10 cents per visit is collected from those who can pay, 44 per cent receiving free service. The cost per operation is $0.57; per visit, $1.26; per person, $4.66; total, $43,457.18 for 1935.

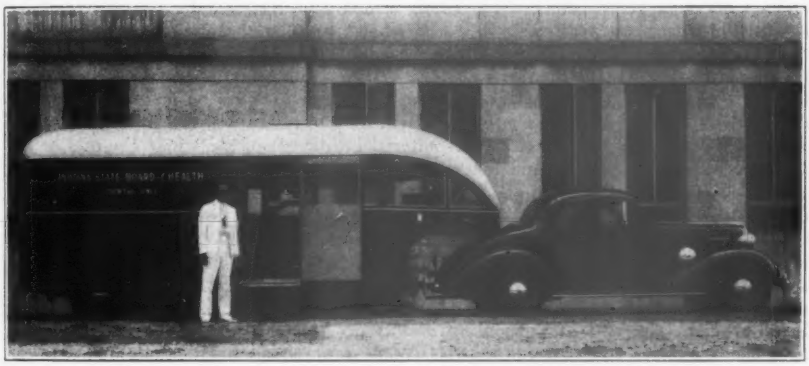
STATEMENT OF RECEIPTS AND DISBURSEMENTS FOR PALAMA SETTLEMENT'S DENTAL CLINIC FOR TWELVE MONTHS ENDING DEC. 21, 1935

Balance on Hand Jan. 1, 1935			$ 3,419.04
Receipts			39,875.75
Strong Foundation		$33,575.00	
Government aid, city and county		3,600.00	
Fees from patients		2,300.75	
Sale of old equipment		375.00	
Rent of clinic (Territorial Board of Examinations)		25.00	
Palama Settlement donation to cover administration and maintenance expenses			5,322.98
Total			$48,617.77
Disbursements			
Salaries		$32,928.79	
Fixed charges			
Insurance on building		66.93	
Supplies and maintenance expenses		7,867.89	
Light, heat, power, water	$ 600.00		
Dental supplies, expendible	2,832.02		
Laundry	313.06		
Household and Plant			
Supplies	273.23		
Repairs and upkeep	283.72		
Clinic equipment	3,565.86		
Office and general expenses		892.59	
Stationery, office supplies	$ 259.24		
Postage	32.37		
Telephones	107.10		
Health education and publicity	436.88		
Office equipment	57.00		
20% pro-rata administration		3,137.50	
and maintenance expenses		2,185.48	
Total disbursements			$47,079.18
Balance on hand, Dec. 31, 1935			$ 1,538.59

INDIANA'S PORTABLE DENTAL OFFICE

A handsome trailer, housing virtually everything that can be found in the finest office, started operations in Jasonville, Ind., this fall. Approximately 6,000 children whose parents are on relief will receive treatment in Greene and Owen counties, after which the office on wheels will move on to new territory. Furnished to please the eye as well as satisfy practical needs, the trailer is equipped with hot and cold running water driven by an air compressor, a clothes closet, supply cabinets, a laboratory work bench, a sink, a sterilizer, an instrument cabinet and a dental chair of

latest design, with modern lighting equipment. The cheerful influence of the furnishings is augmented by spacious screened windows and skylights. The trailer is wired for electric lighting, either from a battery or from alternating current in towns where such current is available. An electric heater will supply warmth during the cold months. The trailer is 21 feet long and equipped with hydraulic brakes and superfine shock absorbers to protect the delicate instruments which the dentist will carry with him.



Indiana's Portable Dental Office. (See pp. 2004-2007.)

Dentistry Unit Established

The establishment of a division of dentistry of the state department of health and the appointment of P. D. Brooker, South Carolina dentist, as its first director, has been announced by James A. Hayne, state health officer. The division will be financed by social security funds provided by the children's bureau of the department of labor. It will be primarily concerned with the dental welfare of children at the outset. Dr. Brooker, a Columbia man, is a former president of the South Carolina State Dental Association and a former president of the state board of dental examiners. For a number of years he was engaged in the establishment of dental clinics at schools, orphanages and charitable and penal institutions. During the World War, he was an examiner for the dental corps. His appointment was recommended by the state dental association. Offices for the division have been opened at 925 Main Street with the division of maternal and child health. Dr. Brooker has said that definite plans for the division were still in the process of formation but that "the activities of the department will be directed particularly toward conservation of children's teeth and to minimize the effects of deleterious dental work on the public health." Another object, he said, will be the general advocacy of oral hygiene as a measure in the control of contagious and infectious diseases.

Mississippi Dental Amendment

March 26, 1936, the governor of Mississippi signed a bill sponsored by the Mississippi Dental Association which greatly strengthens the state dental law. The new law, patterned much after the Oregon Law, empowers the state board of dental examiners to have violators of any part of the law prosecuted. It prohibits the use of glaring signs, advertisements of prices and claims regarding superiority of dental work and the performance of dental operations painlessly. The state legislature passed the bill by a large majority, ninety-four representatives and nineteen senators voting for it, twenty-one representatives and 6 senators against it.

According to A. B. Keeley, secretary-treasurer of the Mississippi State Board of Dental Examiners, Mississippi is the twenty-ninth state to pass such a law.

ORDER TO CEASE AND DESIST—UNITED STATES OF AMERICA
BEFORE FEDERAL TRADE COMMISSION

At a regular session of the Federal Trade Commission held at its office in the City of Washington, D. C., on the 6th day of July, A.D. 1936.

COMMISSIONERS: Charles H. March, chairman,
Garland S. Ferguson, Jr.,
Ewin L. Davis,
William A. Ayres,
Robert E. Freer,

In the matter of
DR. S. B. HEININGER

Pursuant to the provisions of an Act of Congress approved September 26, 1914, entitled "An Act to Create a Federal Trade Commission, to define its powers and duties, and for other purposes," the Federal Trade Commission issued and served its complaint against the respondent herein, Dr. S. B. Heininger, an individual with his principal place of business in the City of Chicago, in the State of Illinois, charging him with the use of unfair methods of competition in interstate commerce in violation of the provisions of Section 5 of said Act. Thereafter the said respondent filed his answer to the charges contained in the said complaint and subsequent thereto on, to wit, the 29th day of June, 1936, a stipulation as to the facts was entered into between the Chief Counsel of the Federal Trade Commission and the respondent herein, subject to the approval of the Federal Trade Commission, in and by which stipulation it was agreed that the statement of facts therein stipulated might be taken as the facts in this proceeding in lieu of testimony, in support of the charges stated in the said complaint or in opposition thereto; and in and by which stipulation it was agreed that the Commission might proceed upon said stipulation of facts to make its report stating its findings as to the facts (including inferences which it might draw from the said stipulation as to the facts) and its conclusion based thereon, and its order disposing of this proceeding without the presentation of argument or the filing of briefs; and the Commission having accepted and approved the said stipulation as to the facts and having made the findings as to the facts and its conclusion that the respondent has violated the provisions of an Act of Congress approved September 26, 1914, entitled "An Act to Create a Federal Trade Commission, to define its powers and duties, and for other purposes."

NOW, THEREFORE, IT IS HEREBY ORDERED that said respondent, Dr. S. B. Heininger, his officers, agents, servants and employees in the sale and offering for sale by him in interstate commerce and in the District of Columbia of dental plates, false teeth, and similar products, forthwith cease and desist from:

Representing in newspapers and magazines and through circulars, catalogues, labels or in any other form of printed matter or by radio broadcasting, or in any other way or manner:

(1) That purchasers or prospective purchasers of respondent's artificial teeth can make as correct impressions of their own teeth and gums as members of the dental profession;

(2) That from impressions made by purchasers or prospective purchasers of their own teeth and gums respondent can make artificial teeth that will give full power of mastication;

(3) That artificial teeth sold or offered for sale by respondent and made by him from impressions made by such purchasers and prospective purchasers of their own teeth and gums will look and feel better than the wearer's own teeth;

(4) That purchasers or prospective purchasers can secure from respondent artificial teeth that fit as well and are as comfortable as those made in the usual way by members of the dental profession;

and from making any other representations of similar tenor or import.

AND IT IS HEREBY FURTHER ORDERED that the said respondent shall within sixty (60) days from the date of the service upon it of this order file with this Commission a report, in writing, setting forth the manner and form in which it shall have complied with this order.

By the Commission

(S E A L)

OTIS B. JOHNSON, *Secretary.*

DENTAL PRACTICE ACT PASSED BY THE MISSISSIPPI LEGISLATURE IN THE REGULAR SESSION, 1936

HOUSE BILL NO. 422

By: Messrs: Bailey, Cowden, McNeer,
Bickerstaff, Etheridge,
Williams (Grenada),
Kelly (Yazoo)

To: Public Health and Quarantine.

AN ACT TO AMEND SECTION 4321 OF THE MISSISSIPPI CODE OF 1930 SO AS TO PROVIDE THAT THE LICENSE OF ANY DENTIST OR DENTAL HYGIENIST SHALL BE REVOKED FOR UNPROFESSIONAL CONDUCT, AND TO MORE CLEARLY DEFINE UNPROFESSIONAL CONDUCT.

SECTION 1. BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF MISSISSIPPI, that Section 4321 of the Mississippi Code of 1930 be and the same is hereby amended so as to read as follows:

4321. License suspended for cause. The State Board of Dental Examiners shall, upon satisfactory proof, revoke or suspend the license of any licensed dentist or dental hygienist practicing in the State of Mississippi, for any of the following:

1. Misrepresentation in obtaining a license, or a wilful violation of any of the provisions of Chapter 104 of the Mississippi Code of 1930, and amendments thereto.

2. Gross immorality or habitual use of intoxicants or drugs rendering said person unfit for the practice of dentistry or dental hygiene.

3. Malpractice, gross ignorance, incompetency, or the employing of unlicensed persons to perform work which, under Chapter 104 of the Mississippi Code of 1930, and amendments thereto, can only be done legally by persons holding a license to practice in this state.

4. Any unprofessional conduct, which shall include the following:

(a) Committing any crime involving moral turpitude.

(b) Practicing deceit or other fraud upon the public.

(c) Practicing dentistry or dental hygiene under a false or assumed name.

(d) Advertising professional superiority or the performance of professional service in a superior manner; advertising prices for professional service; advertising by means of large display, glaring light sign or containing as a part thereof the representation of a tooth, teeth, bridgework or any portion of the human head, or employing or making use of advertising solicitors or free publicity press agents; advertising any free dental work or free examination; advertising to guarantee any dental service or to perform any dental operation painlessly; or advertising any commercial dental laboratory or clinic, either pay or free, when same is operated in connection with the practice of a licensed dentist or dental hygienist.

SECTION 2. That this Act take effect and be in force from and after its passage.

Approved by the Governor,
March 26, 1936

MISCELLANY

BOOK REVIEWS

Oral Hygiene and the Treatment of Parodontal Diseases. By Russell W. Bunting, D. D. Sc., Professor of Oral Histology and Pathology in the School of Dentistry of the University of Michigan, Ann Arbor, Mich. Illustrated with 80 engravings. 187 pages. Price, $2.50. Published by Lea & Febiger, Philadelphia, 1936.

A book on this subject written by Russell W. Bunting might well be classified as standard without further reference. His clarity of reasoning was never brought to greater fruition than in the writing of this book, and even if a practitioner were not particularly interested in the subject, he could not fail of marked attention after reading the first few pages. The volume is not a heavy treatise in any sense of the word, and for that reason it is more attractive and readable. If this book were placed in the hands of every beginner and he was directed to make himself familiar with it at the outset of his dental career, he would assuredly become a better dentist. The subject is at the very foundation of success in the saving of the natural teeth, and to save the natural teeth is the highest expression of successful dental practice. We commend the book in every way.

Influence of Diet on Caries in Children's Teeth (Final Report). By the Committee for the Investigation of Dental Disease (Assisted by Alan Deverall and Mabel Reynolds). Published under the auspices of the Medical Research Council, and issued by the National Institute for Medical Research, Hampstead, London, N. W. 3, England, 1936. Price, 2s. net.

To study this report is to delve into a great mass of material, some of which has previously been published in one form or another, while much of it is presented for the first time.

The work of Mrs. Mellanby naturally comes in for much consideration. The Medical Research Council was fortunate in having access to institutions where large numbers of children could be kept under similar environments; in fact, in no other way were reliable data available. The value of this kind of institutional study is unquestionable though it may be said that the findings in some of these studies did not always tally well with the experience of dentists in general practice.

The whole question of dental caries is still in more or less confusion as has been repeatedly shown, but this is all the greater reason why studies of the character indicated in this report should be followed with even greater zeal. This report will be read with much interest particularly by those who have given the subject thought in the past. In fact, it should enlist the consideration of every member of the profession.

DEATHS

Bartholomew, Thomas C., Detroit, Mich.; Detroit College of Medicine, Department of Dental Surgery, 1901; died recently.

Bates, Carl De Witt, Chicago, Ill.; Chicago College of Dental Surgery, 1897; died August 9; aged 62.

Buehrer, Geoffry Carl, Baltimore, Md.; University of Maryland, School of Dentistry and Baltimore College of Dental Surgery, 1918; met death by accidental drowning, August 16. Dr. Buehrer was a musician of note, holding a degree in academic music from Columbia University and having studied voice, piano and organ under distinguished teachers in this country and abroad. He was born in Switzerland and had marked linguistic ability, having lived in France, Italy and Germany. His zeal for scholarship and research led him to take up the study of dentistry, and he spent much time and energy on problems of health. He took graduate work in Vienna and at the Mayo Clinic and the University of Pennsylvania.

Gatterdam, E. A., La Crosse, Wis.; Creighton University, College of Dentistry, 1881; died August 7; aged 74.

Patten, Clarence, Omaha, Nebr.; Creighton University, College of Dentistry, 1912; died July 14.

Wardner, George H., Portland, Ore.; University of Illinois, College of Dentistry, 1903; died August 18; aged 60. Dr. Wardner had been ill for several months. He was a former president of the Oregon State Dental Association and was for a number of years editor of the *Northwest Journal of Dentistry*. He entered on the study of dentistry after his discharge from the army, having served in the Spanish-American War. Dr. Wardner is survived by his wife, a son and a daughter.

CURRENT LITERATURE

Accident of Local Anesthesia; With Experimental Study of Toxicity of Various Anesthetics (G. Gornori, Surg. Gynec. & Obst., 62:951 [June] 1936): Accidents attendant on local anesthesia are to be divided into two groups; (1) true intoxication resulting from overdosage and (2) acute shock, the pathologic mechanism of which is not well understood. In the first group belong those in which true intoxication results from a relative or absolute overdosage. The symptoms are psychic excitation, mental confusion, violent clonic convulsions and partial transient palsies. Halle reports two cases in this group in which the patient received a 5 per cent solution instead of a 0.5 per cent, through a mistake of the pharmacist. Shuberth reported two cases in one of which 125 c.c. of a 0.2 per cent pantocaine solution was poured into the peritoneal cavity and in the other of which 175 c.c. of a 0.1 per cent pantocaine solution was injected into the scalp over a large area. In the second group, the patient, after receiving a comparatively insignificant amount of the anesthetic suddenly develops a condition closely resembling profound collapse. The symptoms are anxiety, dizziness, paleness or cyanosis, reduced surface temperature and clamminess of the skin, extreme feebleness of the pulse and, often, loss of consciousness. As to the possibility of hypersensitiveness, an idiosyncrasy or some allergy-like condition, it must be admitted that some patients are known to be hypersensitive to local anesthetics. It does not seem justifiable to attribute to intoxication the accidents classified in the second group. They should be regarded rather as instances of acute shock. Allergy-like hypersensitiveness probably plays a rôle in at least some of the cases. True intoxication in the first group can and should be prevented. With our present knowledge, we have not much hope, meanwhile, of becoming able to prevent or to obviate fatalities belonging in the second group, except, perhaps, by the immediate use of barbital therapy, the results of which seem to be encouraging.

J. Frank Hall.

Observations on Development of Teeth of Cavia Cobaya (M. T. Harman and A. Smith, Anat. Rec., 66:97 [Aug.] 1936): The development of the teeth has been studied in eighty guinea-pig embryos ranging in copulation age from 20 days to 68 days and in postnatal animals varying in age from 1 day to 40 days. The molars and the premolars have been called cheek teeth. There are developed in each half jaw one incisor, no canines, four cheek teeth and one deciduous tooth. The deciduous tooth is resorbed *in utero*. The enamel organs appear between 20 and 25 days. The deciduous teeth come through the gums at between 43 and 48 days. The permanent teeth begin to appear at 55 days in the following order: incisors, second cheek teeth, third cheek teeth, first cheek teeth and fourth cheek

teeth. All the teeth are rootless. The enamel is formed on the anterior surfaces of the incisors and the sides of the cheek teeth. The cheek teeth are compound teeth. The anterior portion is larger than the posterior portion and develops first. Fusion gradually takes place as the single cones enlarge. At the time of birth, the dental pulp and the dentin are continuous at the base. The two parts become firmly united at about 30 or 40 days postnatal life.

M. W. McCrea.

Garlic Breath Odor (M. A. Blankenhorn and C. E. Richards, J.A.M.A., 107: 409 [Aug. 8] 1936): The persistent smell of garlic and onions on the breath has been attributed to exhalation of the essential oils from the lungs following passage into the blood during digestion, and to retention of particles of these foods in the mouth. The authors' experiments with surgical patients supported the former view. The odor of garlic appeared in the breath of patients fed through gastric fistulas; and in patients with surgically separated alimentary and respiratory tracts, the smell was found in the breath and not the esophagus. Mouth washes merely masked the offending odor.

B. G. Bibby.

Dangers Inherent in Clinical Diagnosis of Cancer (D. Merrill, Yale J. Biol. & Med., 8:252 [Jan.] 1936): Cancer may be masked by minor ailments. More detailed histories and physical examinations and specially indicated laboratory studies will be sufficient basis for diagnosis in many cases. Biopsy, the most accurate method of diagnosis, will be found necessary in a high percentage of cases. Instances of obscured diagnosis are cited by the author, including a suspected carcinoma of the jaw that proved to be a scorbutic condition and a case of chronic inflammatory lesion of the tongue in the presence of a Kahn-positive reaction and which healed under antisyphilitic treatment. Correct diagnosis is not merely of academic interest, but also early, accurate diagnosis can determine the course and therapy of the disease.

Hamilton Robinson.

Course of Single Myeloma of Bone: Report of Twenty Cases (M. Cutler, F. Buschke and S. T. Cantril, Surg. Gynec. & Obst., 62:918 [June] 1936): Most authors believe that myeloma of bone is a true tumor, others that it is a generalized disease of the myeloid system. The term "multiple myeloma" has arisen because these tumors spread very early, and are seen after the disease is already generalized. In order to support the opinion that myeloma is a true tumor, observations of cases with a solitary bone lesion with or without subsequent spread of the disease is very important. Of the twenty cases, eighteen are of solitary myeloma of bone; twelve cases from the literature, five from the Bone Registry of the American College of Surgeons and one additional case. Two cases are presented as problems in roentgenologic diagnosis. In five cases, the myeloma was solitary at the first observation and later became generalized. Some of the cases show roentgenologic and histologic peculiarities. Roentgenologically, some had the appearance of a giant-cell tumor and in others a malignant invading growth was noted histologically. These peculiarities in the roentgenologic findings and clinical course must be borne in mind in differentiating giant-cell tumors and myelomas.

J. Frank Hall.

Fundamental Factors in Delay and Nonunion in Fractures (D. S. O'Connor, Yale J. Biol. & Med., 8:37 [Oct.] 1935): Hemorrhage occurs with fracture and the resulting blood in the tissue must be removed by absorption or organization, the former taking place if the blood supply is efficient. If there is organization, an immature form of fibrous tissue evolves in which calcium is deposited to form the callus. This is later transformed into true bone. Nonhealing may be of local or constitutional origin. Constitutional causes are difficult to find and the blame is usually placed on syphilis. The presence of tissue between the fragments, preventing bridging by hemorrhage, failure to approximate fragments, presence of fluid other than blood and infection are common causes of nonhealing.

It is important that a fracture be treated from the moment it occurs as delay is costly in the absence of conditions for normal healing.

HAMILTON ROBINSON.

Probable Cases of Nonunion of Fractures (Henry Turner, J. Bone & Joint Surg., 18:581 [July] 1936): The capacity of fractured bones to solidify in a few weeks is no doubt due to the quick uprising of forces controlled and stimulated by nervous conditions. Bone union takes place by a softening of the fragment ends and a certain degree of autolysis. Acute bone decalcification is an essential part of a biologic process which, in cases of fracture, leads to bone union. This temporary rarefaction is reflex and proceeds from traumatic irritation of the nerve branches that supply the bone and the periosteum. When the irritation subsides, this process is brought to a standstill and is replaced by deposition of lime salts in the newly formed soft callus and the decalcified ends of the fragments. A soldering of the fragments is thus obtained. In some cases, this irritation of the nerve branches continues for a long period and prevents nature from carrying out the normal healing process. Local deficiency of lime salts causes delay in bone union and may even prevent consolidation. In the clinical examination of slowly healing fractures, more attention should be paid to the possible involvement of the peripheral nerve branches. Roentgenographic examination should not be limited to the immediate site of injury.

J. FRANK HALL.

Alcohol Injection in Treatment of Trigeminal Neuralgia (F. C. Grant, J.A.M.A., 107:771 [Sept. 5] 1936): Technics are given for making alcohol injections into the branches of the fifth nerve. In 185 cases of trigeminal neuralgia, the right side was affected in 152 instances and the left in 121. Eighty-seven of the patients were males and 98 females, and 121 of the 185 patients were between 50 and 70 years of age. The second and third divisions of the fifth nerve were equally affected, but the first division was seldom affected. In 331 injections, failure resulted in the first, second and third divisions in 10, 20, and 21 per cent, respectively, and the relief lasted about eleven, fourteen and sixteen months in the respective divisions. The disadvantages of the method are the pain in making the injection and the occasional external rectus palsy (0.7 per cent), facial paralysis (1 per cent and mouth ulceration (4 per cent), which result.

B. G. BIBBY.

FOREIGN LITERATURE

Relation of Pulpless Teeth to General Disease with Special Reference to Periapical Rarefaction (A. Bulleid, Guy's Hosp. Rep., 86:309 [July] 1936): Pulpless teeth are not dead teeth, the cementum being nourished through the periodontal membrane. The dentin, periodontal membrane, periapical region and cementum yield positive cultures by appropriate aerobic and anaerobic technic even after employment of root-canal antiseptics. About 40 per cent of the cases show positive dentinal cultures, and 100 per cent give positive periodontal cultures, although, in the latter, possible oral contamination must be admitted. As a result of pulpal and periapical infection, rarefying or sclerosing osteitis may be seen in one of five types: rarefaction with sclerosis, or without sclerosis, granuloma, chronic periapical abscess or dental root cyst. In 100 per cent of cases of extracted pulpless teeth, streptococci were isolated from the interior of granulomas, from chronic apical abscesses and also from the apices of pulpless teeth *in situ*. Streptococci were cultivated from the epithelial linings of 100 per cent of the cysts and from the cystic fluid in 75 per cent of instances. About 1,000 teeth were examined and 10 per cent of the streptococci recovered were hemolytic. Septicemia from periapical sepsis is rare. The usual effect is an "overload" of the system by a toxemia or bacteremia. The exotoxins of the nonhemolytic streptococci are of a relatively low pathogenicity. Absolute proof of the relation between infected pulpless teeth and systemic

diseases is lacking because other foci cannot be ruled out. The author feels that no focus of infection should be tolerated, but that the problem of possible mutilation should be considered. Apicoectomy seems to offer some hope for successful treatment. Minimal instrumentation is advised as overly vigorous mechanical therapy seems to favor development of rarefaction of a more dangerous type.

HAMILTON ROBINSON.

Two Cases of Fracture of Roots of Two Incisors Where Pulps Have Remained Vital (W. E. Herbert, Proc. Roy. Soc. Med., 29:1098 [July] 1936): Roentgen-ray examination revealed transverse fractures of the roots of the maxillary left first and second incisors of a 12-year-old boy. These teeth responded normally to thermal changes. One and one half years previously, the first incisors had been chipped in an accident and again, a few months previous to examination, the second incisor was injured. In another case, two teeth loosened in a sports accident and when splinted gave evidence of fracture with laying down of calcified tissue in the roots by roentgen-ray examination two years later. Thermal response in these teeth, maxillary first incisors, was normal.

HAMILTON ROBINSON.

Osteomyelitis of Mandible, Complicated by Septicemia and Secondary Abscess of Elbow and Hip (G. T. Hankey, Proc. Roy. Soc. Med., 29:1102 [July] 1936): A case of osteomyelitis developing in the mandible after extraction of a second molar preceded by two unsuccessful attempts at extraction over a period of seven months is reported. Septicemia developed together with secondary abscesses of the elbow and beneath the gluteal muscles. The patient recovered after incision and drainage, transfusions, splinting and removal of sequestra and teeth in the area. The author warns against the danger of added trauma opening up new avenues of infection if attempt is made to remove broken roots before bruising and sepsis have subsided. Simple incision and drainage are preferable.

HAMILTON ROBINSON.

Dental Decay as Index of Malnutrition (P. A. Eamshaw, M. J. Australia, 2:4 [July 4] 1936): Following a review of the onset of dental decay in primitive races, especially in Australia, the author decides that "nothing other than the alteration of the diet can account for the invariable appearance of dental disease." He emphasizes the importance of systemic factors in causation of caries and states that the earliest signs of malnutrition occur in the teeth. The excessive use of sugar—112 pounds per annum in Australia—and of white flour is considered most harmful. To rectify this, a foundation diet based on the recommendations of the League of Nations Committee on Physiological Bases of Nutrition is offered. This largely replaces white flour by potatoes and lightly milled cereals. Reports are given of cases of caries in infants' mouths which were related to malnutrition and occurred before local conditions could have had an effect.

B. G. BIBBY.

Variations in Saliva in Pyorrhea and Caries (D. J. Martin, D. J. Australia, 8:409 [July] 1936): In a series of colorimetric observations of the hydrogen-ion concentration of the saliva, the author found that the variations did not follow those of the urine. In eleven patients with caries, the saliva was slightly more acid (p_H 6.34) than in thirty-seven patients with healthy mouths (p_H 6.87) and seventy-three pyorrheics (p_H 7.11). In young patients, the p_H was lower than in old.

B. G. BIBBY.

Constructive and Destructive Processes in Bones and Teeth of Normal and Scorbutic Animals (J. Hertz, Acta Path. et Microbiol. Scandinav., 13:329, 1936): When bone is formed, according to the Hansen-Haggqvist concept, the endoplasm (cells) of the hyaline cartilage forms an osteoblastema and deposits chondrin in the exoplasm (matrix) to determine the characteristic consistency. The breakdown of osseus tissue is accompanied by the disappearance of the calcium and collagen with an unmasking of protoplasm. These unmasked endoplasmic areas give an appear-

ance of multinucleated giant cells or osteoclasts. These giant cells are not seen when necrotic bone breaks down except as foreign body giant cells. In the healing of normal bone in 256 rats and guinea-pigs, an inflammatory process with formation of granulation tissue, which becomes an osteoblastema, was noted. The deposition of calcium and collagen forms the osteoid trabeculae. In scorbutic animals, there is a delay in the inflammatory process paralleling the reduced inflammatory reaction in scorbutic carious teeth pointed out by Westin. The capacity to form osteoblastema is almost completely lacking in scurvy, but the ability to absorb and bind calcium is increased, resulting in heavy amorphous deposits. As little collagen is deposited, the formed bone is unusually brittle. The jaws of forty-nine guinea-pigs (sixteen normal, twenty-seven scorbutic and six recovering from scurvy) were studied. In the incisors of the normal animals, dentin formation constantly takes place by the conversion of odontoblastema into predentin and then dentin. Dental tissues break down in the same manner as bone, with the appearance of unmasked protoplasm. In scorbutic animals, the pulp shows dilated vessels, hemorrhage and cystic cavities. The odontoblastema suffers first and most, but antiscorbutics will reverse the process. The dentin formed is poorer in quality and thinner. The formed dentin is unmasked, giving the appearance of widened tubules, and the nonuniform degeneration of the dentin results in dendritic projections in the pulp. As all these changes are most severe occlusally, a cross-section of the jaw may miss them. A lack of transition of supporting structures into alveolar bone is seen in scurvy and there is hemorrhage into the periodontal tissues, which may be a factor in the loosening of the teeth. With a high incidence of scorbutic changes, a low caries incidence was exhibited. This relationship, together with the clinical observation of high pyorrhea-low caries incidence, suggests a relationship between pyorrhea and scurvy.

HAMILTON ROBINSON.

Intravenous Anesthesia with Eunarcon (V. Akerblom, Nord. med. Tidsskr., April 11, 1936, p. 607): The author describes his experience with 125 cases during the past two years with intravenous injections of eunarcon. Sixty of the cases represented outpatient material. About thirty-eight cases were dental extractions. Diseases of the liver and biliary passages, septic infection, and peritonitis were regarded as contraindications for the anesthetic. At first, it was not considered very satisfactory, probably because it had been injected too rapidly and in too large quantities. After many corrections of the technic, dental extractions proceeded most satisfactorily. It was also used successfully for the setting of fractures and reduction of dislocations because of its good muscular relaxation. The after-effects are better than those attending the use of ethyl chloride.

F. FRANK HALL.

Studies of Mouth Spirochetes (S. Okabe, Centralbl. f. Bakteriol., 136:485 [June 12] 1936): Studies of mouth spirochetes were made in Giemsa stained material from the nose, nasopharynx, pharynx, tongue, tonsil and teeth of twenty-seven healthy individuals, twenty-two with nasal lesions and twenty-one with infections of throat and mouth. Spirochetes and fusiform bacilli were found in all material from the teeth, but less regularly from other sites. *Spirochaeta buccale* and *Spirochaeta dentium* occurred, respectively, in 100 per cent and 90 per cent of the healthy teeth, 100 per cent and 94 per cent of the tonsils and smaller percentages at the other sites. Pure cultures were obtained after from two to six stick transfers in a 2 per cent agar medium containing horse's and goat's serum.

B. G. BIBBY.

Culture and Classification of Fusiform Bacteria (K. L. Pesch and L. Schmitz, Centralbl. f. Bakteriol., 136:476 [June 12] 1936): Using serum or blood agar with anaerobic incubation, the authors made a total of 193 cultures of fusiform bacteria. Seventy-five strains in one series were classified into six types on the basis of morphology and colonies. All fermented glucose

and sucrose, but not maltose. Seventeen strains were isolated from twenty-one normal mouths, twenty-two from nine carious teeth, seventeen from six ulcerated mouths, fourteen from cases of untreated paradentosis and five from six cases of Vincent's infection.

B. G. Bibby.

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association, Atlantic City, N. J.

Academy of Anesthesiology in Oral Surgery, New York City, October 14.

American Dental Society of Europe, Paris, France, August 2-5.

American Society of Orthodontists, Chicago, April 19-22.

Chicago Dental Society, February 15-18.

Greater New York Meeting, December 7-11.

Marquette University Dental Alumni Association, Milwaukee, October 21-24.

New England Dental Society, Boston, Mass., October 28-29.

New York Society of Dental History and Culture, New York City, October 15.

Odontological Society of Western Pennsylvania, Pittsburgh, October 27-29.

Society for the Advancement of General Anesthesia in Dentistry, New York City, third Monday in February, April, October and December.

Southern Society of Orthodontists, Atlanta, January 25-27.

District of Columbia at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

Great Lakes Association of Orthodontists, Toronto, Canada, October 19-20.

Montreal Dental Club and Canadian Dental Association, Montreal, October 14-16.

American Association for the Advancement of Science, Subsection on Dentistry, Atlantic City, N. J., December 28.

STATE SOCIETIES

October

Florida, at Orlando (5-7)

November

Ohio, at Cleveland (9-11)

Puerto Rico, at Mayaguez

April

Alabama, at Mobile (12-14)

Wisconsin, at Milwaukee (19-22)

May

Illinois, at Springfield (11-13)

New York, at New York City (11-14)

North Carolina, at Pinehurst (3-5)

Tennessee, at Knoxville (10-13)

June

Maine, at Rangeley (25-26)

STATE BOARDS OF DENTAL EXAMINERS

Connecticut, at Hartford, November 17-21. Almond J. Cutting, Southington, Recorder.

Indiana, at Indianapolis, October 26. J. M. Hale, Mt. Vernon, Secretary.

Iowa, at Iowa City, December 14-18; May 31-June 4. Hardy F. Pool, Mason City, Secretary.

Minnesota, at Minneapolis, December 11-17. Paul Hagen, Crookston, Secretary.

New Hampshire, at Manchester, December 17-19. Otis M. Littlefield, Manchester, Secretary.

New Jersey, at Trenton, December 7-12. State Board of Registration and Examination in Dentistry, 148 W. State St., Trenton.

Wisconsin, at Milwaukee, December 14-18. S. F. Donovan, Tomah, Secretary.

Texas, at Dallas, December 7-10. R. T. Weber, Austin, Secretary.

NORTH CAROLINA DENTAL SOCIETY

The sixty-third annual meeting of the North Carolina Dental Society will be held at the Carolina Hotel, Pinehurst, May 3-5.

Frank O. Alford, *Secretary*,
Charlotte.

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of The Journal.

OHIO STATE DENTAL SOCIETY

The Ohio State Dental Society will hold its seventy-first annual meeting at Hotel Cleveland, Cleveland, November 9-11.

EDWARD C. MILLS, *Secretary,*
255 East Broad St.,
Columbus.

WISCONSIN STATE DENTAL SOCIETY

The sixty-seventh annual meeting of the Wisconsin State Dental Society will be held at the Schroeder Hotel, Milwaukee, April 19-22.

E. E. PARKINSON, *Secretary,*
104 King St.,
Madison.

CONNECTICUT DENTAL COMMISSION

The Connecticut Dental Commission will meet in Hartford, November 17-21, for the examination of applicants for license to practice dentistry and dental hygiene and to transact any other business proper to come before it. Applications should be in the hands of the recorder at least ten days before the meeting. For application blanks and further information, apply to

ALMOND J. CUTTING, *Recorder,*
Southington.

NEW HAMPSHIRE STATE DENTAL BOARD

The next meeting of the New Hampshire State Dental Board will be held in Manchester, December 17-19.

OTIS M. LITTLEFIELD, *Secretary,*
Manchester.

TEXAS STATE BOARD OF DENTAL EXAMINERS

The next examination of the Texas State Board of Dental Examiners will be held in Dallas, December 7-10. There is no reciprocity. Applications must be filed at least ten days prior to the date of examination. For further particulars, address

R. T. WEBER, *Secretary,*
Austin.

NEW ENGLAND DENTAL SOCIETY

The New England Dental Society will hold its forty-second annual meeting at the Forsyth Dental Infirmary, Boston, Mass., October 28-29.

PHILLIP J. JONES, *Assistant Secretary,*
Hartford, Conn.

SOUTHERN SOCIETY OF ORTHODONTISTS

The fifteenth annual meeting of the Southern Society of Orthodontists will be held at the Atlanta Biltmore Hotel, Atlanta, January 25-27.

WILLIAM P. WOOD, JR., *Secretary,*
442 West Lafayette St.,
Tampa.

ACADEMY OF ANESTHESIOLOGY IN ORAL SURGERY

The Academy of Anesthesiology in Oral Surgery will meet October 14 at the George Washington Hotel, New York City. For further information, address

J. M. ESKOW, *Secretary,*
147 Market St.,
Perth Amboy, N. J.

MARQUETTE UNIVERSITY DENTAL ALUMNI ASSOCIATION

The Marquette University Dental Alumni Association will hold its thirtieth annual meeting and clinic October 21-24, at Milwaukee.

J. B. FRANKLIN, *Chairman on Publicity,*
Milwaukee.

MOUNT SINAI HOSPITAL LECTURES

The first lecture in the sixth lecture course in dental medicine at the Mount Sinai Hospital will be given October 8 in the Laboratory Annex Lecture Room. Other lectures will be given throughout the year, the last April 8. All lectures start promptly at 8:30 p.m. For information regarding essayists and subjects, address

HARRY A. GOLDBERG, D.D.S.,
570 Park Ave.,
New York City.

AMERICAN DENTAL SOCIETY OF EUROPE

The next annual meeting of the American Dental Society of Europe will be held in Paris, August 2-5.

K. C. CAMPBELL, *Secretary,*
88 Portland Place,
London, W. 1.

OFFICERS AND TRUSTEES OF THE AMERICAN DENTAL ASSOCIATION
1936-1937

PRESIDENT

Leroy M. S. Miner.....363 Marlborough St., Boston, Mass.

PRESIDENT ELECT

C. Willard Camalier.....1726 Eye St., N.W., Washington, D. C.

VICE PRESIDENTS

Raoul H. Blanquie.....Flood Bldg., San Francisco, Calif.
James V. Gentilly.....Rose Bldg., Cleveland, Ohio
James A. Blue.....Comer Bldg., Birmingham, Ala.

SECRETARY

Harry B. Pinney.....212 E. Superior St., Chicago, Ill.

TREASURER

R. H. Volland.....First Capital Nat'l Bank Bldg., Iowa City, Iowa

BOARD OF TRUSTEES

Leroy M. S. Miner, President, Ex-Officio....363 Marlborough St., Boston, Mass.
C. Willard Camalier, President Elect, Ex-Officio.....
.....1726 Eye St., N.W., Washington, D. C.
Harry B. Pinney, Secretary, Ex-Officio.....212 E. Superior St., Chicago, Ill.
R. H. Volland, Treasurer, Ex-Officio.....
.....First Capital Nat'l Bank Bldg., Iowa City, Iowa
Harvey J. Burkhart, '39.....Box 879, East Avenue P. O., Rochester, N. Y.
C. R. Lawrence, '39.....730 Bass Bldg., Enid, Okla.
Herbert C. Miller, '39.....E. 6th and Oregon Sts., Portland, Ore.
Wilfred H. Robinson, '39.....1706 Broadway, Oakland, Calif.
J. Ben Robinson, '38.....Medical Arts Bldg., Baltimore, Md.
Thomas L. Grisamore, '38.....29 E. Madison St., Chicago, Ill.
E. G. Meisel, '38.....121 University Place, Pittsburgh, Pa.
C. J. Caraballo, '38.....Stovall Bldg., Tampa, Fla.
George E. Morgan, '38.....2039 North Prospect Ave., Milwaukee, Wis.
J. G. Hildebrand, '37.....Waterloo, Iowa
Albert R. Ross, '37.....Murdock Bldg., Lafayette, Ind.
Oren A. Oliver, '37.....Medical Arts Bldg., Nashville, Tenn.
Philip E. Adams, '37.....106 Marlborough St., Boston, Mass.